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Earth Resources
A Continuing
Bibliography
with Indexes

NASA SP-7041 (20)
February 1989

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A Continuing Bibliography with Indexes

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NASA SP-7041 (60)

EARTH RESOURCES

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 60

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between October 1 and December 31 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

National Aeronautics and Space Administration
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INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the Earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the Earth's lands and waters, by sensing instrumentation on orbiting spacecraft or on aircraft.

This literature survey lists 485 reports, articles, and other documents announced between October 1 and December 31, 1988 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techiques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography are also included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations include the original accession numbers from the respective announcement journals.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

IAA entries identified by accession number series A88-10,000 in ascending accession number order;

STAR entries identified by accession number series N88-10,000 in ascending accession number order.

After the abstract section, there are seven indexes:

subject, personal author, corporate source, foreign technology, contract number, report/accession number, and accession number.

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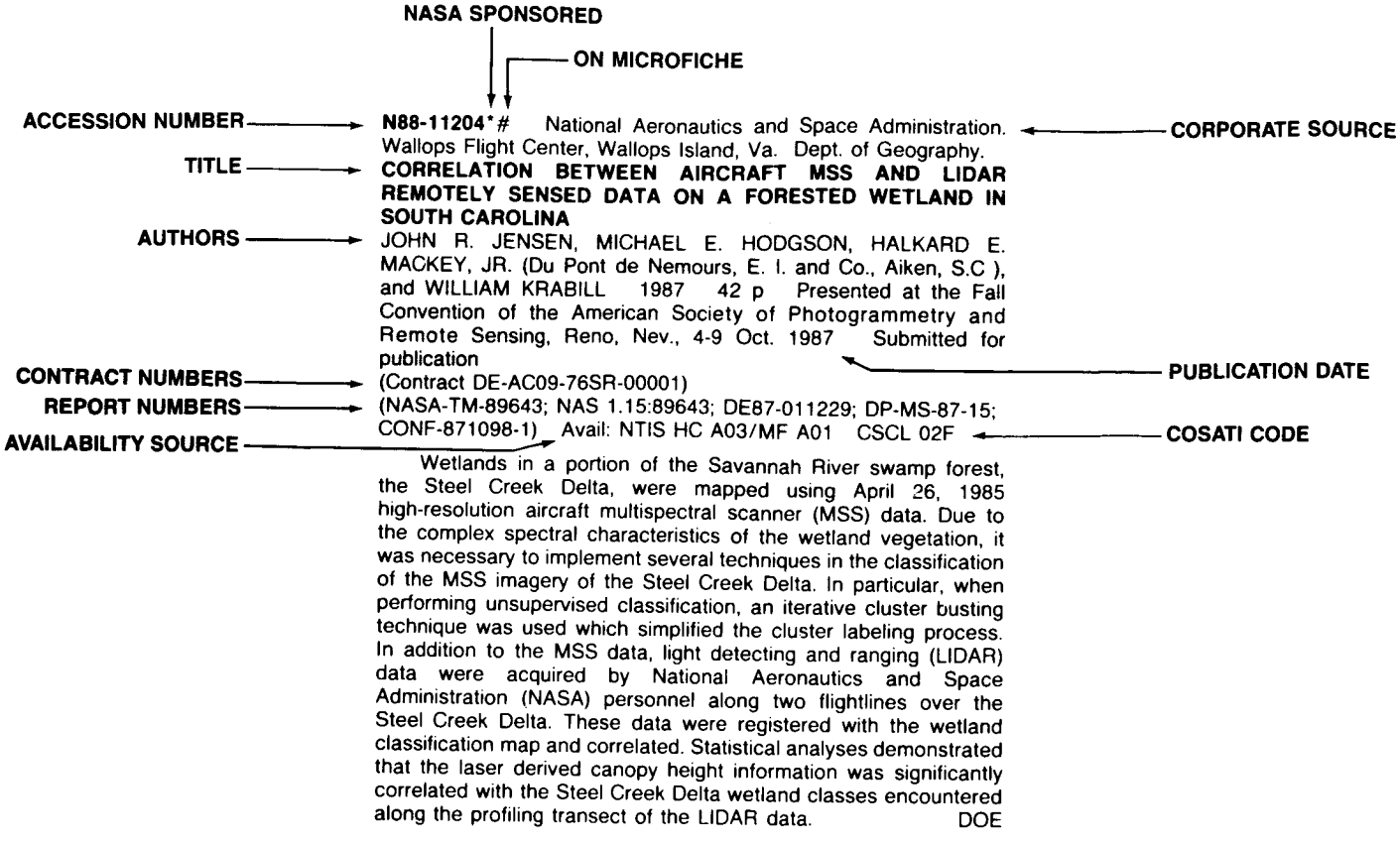
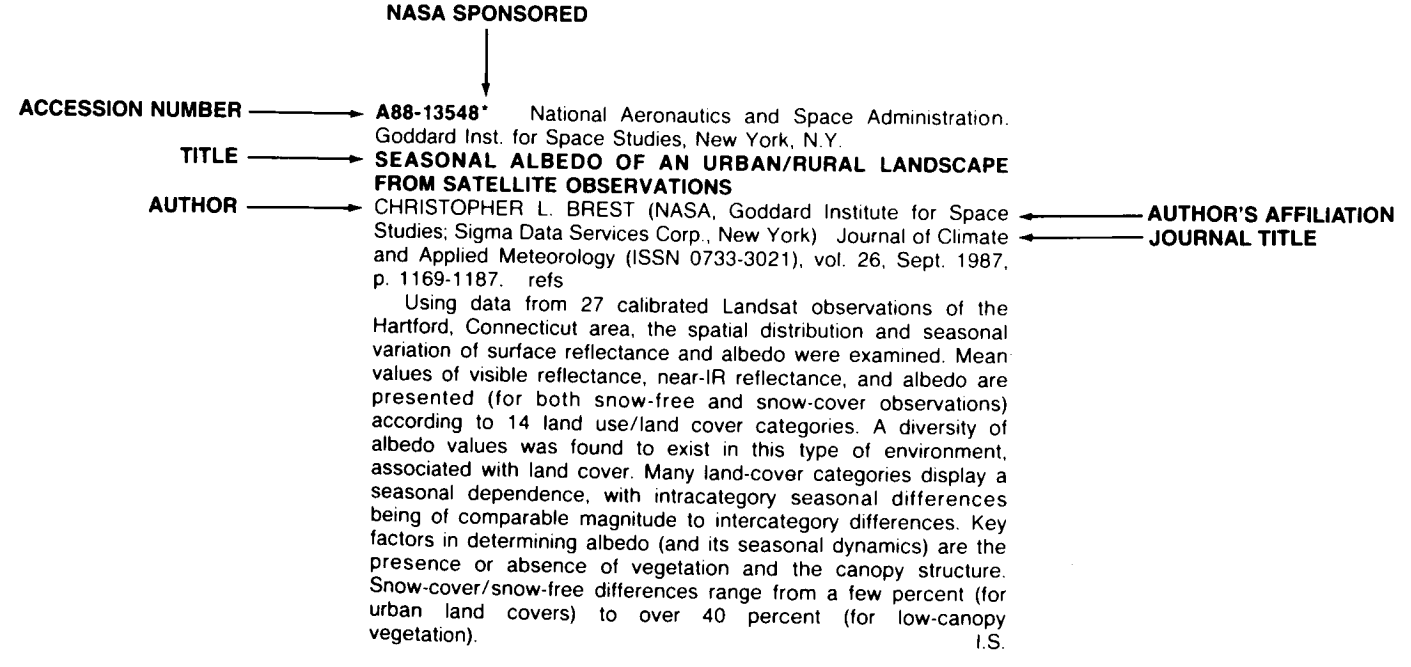
TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



EARTH RESOURCES

A Continuing Bibliography (Issue 60)

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01

AGRICULTURE AND FORESTRY

Includes crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventry, forest fire detection, and wildlife migration patterns.

A88-46354
STUDY OF A SPOT 1 SCENE - CROP INVENTORY AND PREDICTION OF THE WINTER DURUM WHEAT HARVEST (BEAUCE, FRANCE) [ETUDE D'UNE SCENE SPOT 1 - INVENTAIRE DES CULTURES ET PREVISION DE RENDEMENT DU BLE DUR D'HIVER /BEAUCE, FRANCE/]
P. BOISSARD, J.-G. POINTEL, and P. BELLUOMO (Institut National de la Recherche Agronomique, Station de Bioclimatologie, Thiverval-Grignon, France) Photo Interpretation (ISSN 0031-8523), vol. 26, Mar.-Apr. 1987, p. 39-43, 45. In French, English, and Spanish.

A88-46359
STUDY OF TWO CLOSELY-DATED MULTITEMPORAL SPOT 1 IMAGES OBTAINED DURING THE MATURATION OF WINTER WHEAT (ILE-DE-FRANCE, FRANCE) [ETUDE DE DEUX IMAGES MULTITEMPORELLES RAPPROCHEES DE SPOT 1 ACQUISES A LA MATURATION DU BLE H'HIVER /ILE-DE-FRANCE, FRANCE/]
P. BOISSARD, J.-G. POINTEL (Institut National de la Recherche Agronomique, Station de Bioclimatologie, Thiverval-Grignon, France), and D. LANQUETUIT (Seine-et-Marne, Chambre d'Agriculture, Le Mee-sur-Seine, France) Photo Interpretation (ISSN 0031-8523), vol. 26, July-Aug. 1987, p. 25-29, 31, 33. In French, English, and Spanish.

A88-46768*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, Miss.
RESPONSE TO SOIL MOISTURE OF SPECTRAL INDEXES DERIVED FROM BIDIRECTIONAL REFLECTANCE IN THEMATIC MAPPER WAVEBANDS
H. BRAD MUSICK and RAMONA E. PELLETIER (NASA, National Space Technology Laboratories, Bay Saint Louis, MS) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, July 1988, p. 167-184. refs

Laboratory reflectance measurements of 10 soils were used to determine the relationship between soil moisture and three spectral indices: the TM5/7 ratio and the Wetness(R) and Brightness(R) features of the reflectance factor TM Tasseled Cap transformation. Response of the indices to dry mass water percentage was approximately linear for individual soils, except for Wetness(R) and Brightness(R) at high moisture content. Soil differences in the slopes of the Wetness(R)- and Brightness(R)-moisture content relationships were almost entirely eliminated by expressing water content as the percentage of water retained at 0.1 bar (10 kPa) tension (relative water content). The resultant soil lines were offset from one another by the differences in dry soil index value. Slope of the TM5/7 response was not completely normalized by expressing moisture status as relative water content, because slope appeared to vary with dry soil ratio value. Sensitivity to the effects of illumination angle was negligible for the TM5/7 ratio, somewhat greater for Wetness(R) and greatest for Brightness(R). Author

A88-46769*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ESTIMATING BIG BLUESTEM ALBEDO FROM DIRECTIONAL REFLECTANCE MEASUREMENTS
J. R. IRONS, K. J. RANSON (NASA, Goddard Space Flight Center, Greenbelt, MD), and C. S. T. DAUGHTRY (USDA, Remote Sensing Research Laboratory, Beltsville, MD) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, July 1988, p. 185-199. refs

Multidirectional reflectance factor measurements acquired in the summer of 1986 are used to make estimates of big bluestem grass albedo, evaluating the variation of albedo with changes in solar zenith angle and phenology. On any given day, the albedo was observed to increase by at least 19 percent as solar zenith angle increased. Changes in albedo were found to correspond to changes in the green leaf area index of the grass canopy. Estimates of albedo made using reflectance data acquired within only one or two azimuthal planes and at a restricted range of view zenith angle were evaluated and compared to 'true' albedos derived from all available reflectance factor data. It was found that even a limited amount of multiple direction reflectance data was preferable to a single nadir reflectance factor for the estimation of prarie grass albedo. R.B.

A88-47439* TGS Technology, Inc., Moffett Field, Calif.
SPECULAR, DIFFUSE AND POLARIZED IMAGERY OF AN OAT CANOPY
VERN C. VANDERBILT (TGS Technology, Inc., Moffett Field, CA) and KURT J. DE VENECIA (Helava Associates, Inc., Southfield, MI) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 26, July 1988, p. 451-462. refs
(Contract NAG5-269)

Light, polarized by specular reflection, has been found to be an important part of the light scattered by several measured plant canopies. The authors investigate for one canopy the relative importance of specularly reflected sunlight, specularly reflected light from other sources including skylight, and diffusely upwelling light. Polarization images are used to gain increased understanding of the radiation transfer process in a plant canopy. Analysis of the results suggests that properly analyzed polarized remotely sensed data, acquired under specific atmospheric conditions by a specially designed sensor, potentially provide measures of physiological and morphological states of plants in a canopy. I.E.

A88-49081
EVALUATION OF SINGLE-BAND-VIDEO AND VIDEO-BAND-BASED INDICES FOR GRASSLAND PHYTOMASS ASSESSMENT
J. H. EVERITT, D. E. ESCOBAR, and R. VILLARREAL (USDA, Agricultural Research Service, Weslaco, TX) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Aug. 1988, p. 1177-1180. refs

Single-band-video and video-band-based vegetation indices (composite images) were evaluated for their potential to assess phytomass production within grass plots that were fertilized with

five rates of nitrogen. Eleven single-band images were acquired by equipping four black-and-white video cameras with visible and IR narrowband filters. Thirteen vegetation indices were produced on an image processor from the various single-band (composite) images. Digital data were obtained from the 24 images and regressed on amounts of phytomass. Coefficients of determination (r squared) from four single-band images (orange-red, red, dark red, and IR) were significant. Moreover, r squared values calculated from 12 of the indices were significant (all at $p = 0.01$). The only nonsignificant coefficient was obtained from regressing transformed-vegetation-index digital data on amount of phytomass. Although the significant coefficients obtained from the indices varied, a qualitative evaluation of the various composite images showed them to be similar for separating among the fertilizer treatments. These results indicate both single-band-video and video-vegetation-indices will be useful to assess the amount of grass phytomass production. Author

A88-49082
AIRBORNE LASER PROFILE DATA FOR MEASURING EPHEMERAL GULLY EROSION
T. J. JACKSON, J. C. RITCHIE (USDA, Hydrology Laboratory, Beltsville, MD), J. WHITE (PhotoScience, Inc., Gaithersburg, MD), and L. LESCHACK (Trident Arctic Exploration, Ltd., Calgary, Canada) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Aug. 1988, p. 1181-1185. refs

The feasibility of using airborne laser measurements of surface heights as a method for providing information on ephemeral gully erosion was investigated. Laser profile data were obtained over control fields with both artificial and natural gullies and recorded at 4000 pulses per second at a nominal aircraft speed of 25 m/s and altitudes of 50 and 100 m. A moving-average filter was used to remove random noise and surface microroughness effects. Analysis of the data from the artificial and natural gully fields clearly indicated the location and cross section of gullies as small as 50 cm wide and 15 cm deep. These results demonstrated the feasibility of the approach because the tested conditions were what would be considered very small gullies. Author

A88-49083* California Univ., Santa Barbara.
A COMPOSITE L-BAND HH RADAR BACKSCATTERING MODEL FOR CONIFEROUS FOREST STANDS
GUOQUING SUN and DAVID S. SIMONETT (California, University, Santa Barbara) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Aug. 1988, p. 1195-1201. refs
(Contract JPL-956887)

The radar backscattering model developed by Richards et al. (1987), has been improved and further tested in this research. The trunk term may now be calculated from the exact solution to the electromagnetic wave equations instead of the corner reflector equation. Rough surface models have been introduced into the radar model, so that the forward reflectance and the backscattering from the ground surface are now calculated from the same model and, thus, are consistent. The number of trees in an individual pixel is assumed to be Poisson distributed, with tree height in a stand log-normally distributed. The simulated results show that the match of backscattering coefficients for eight forest stands between SIR-B image data and the simulated results are satisfying, and that the trunk term now seems to be convincingly established as the dominant term in the L-band HH radar return from coniferous forest stands. Author

A88-49361
SIR - A IMAGE OF ABU DHABI
RAY HARRIS (Durham, University, England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1051, 1052.

A88-49366* Texas Univ., Arlington.
ELECTROMAGNETIC SCATTERING FROM A LAYER OF FINITE LENGTH, RANDOMLY ORIENTED, DIELECTRIC, CIRCULAR CYLINDERS OVER A ROUGH INTERFACE WITH APPLICATION TO VEGETATION
M. A. KARAM and A. K. FUNG (Texas, University, Arlington) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1109-1134. refs
(Contract NAG5-486)

A scattering model for defoliated vegetation is developed by treating a layer of defoliated vegetation as a collection of randomly oriented dielectric cylinders of finite length over an irregular ground surface. Both polarized and depolarized backscattering are computed and their behavior versus the volume fraction, the incidence angle, the frequency, the angular distribution and the cylinder size are illustrated. It is found that both the angular distribution and the cylinder size have significant effects on the backscattered signal. The present theory is compared with measurements from defoliated vegetations. Author

A88-49735* National Center for Atmospheric Research, Boulder, Colo.
RADIATION TRANSFER IN PLANT CANOPIES - SCATTERING OF SOLAR RADIATION AND CANOPY REFLECTANCE
MICHEL M. VERSTRAETE (National Center for Atmospheric Research, Boulder, CO) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Aug. 20, 1988, p. 9483-9494. refs
(Contract NASA ORDER S-56469)

The one-dimensional vertical model of radiation transfer in a plant canopy described by Verstraete (1987) is extended to account for the transfer of diffuse radiation. This improved model computes the absorption and scattering of both visible and near-infrared radiation in a multilayer canopy as a function of solar position and leaf orientation distribution. Multiple scattering is allowed, and the spectral reflectance of the vegetation stand is predicted. The results of the model are compared to those of other models and actual observations. Author

A88-50282* New York State Univ., Binghamton.
ESTIMATION OF CANOPY PARAMETERS FOR INHOMOGENEOUS VEGETATION CANOPIES FROM REFLECTANCE DATA. III - TRIM: A MODEL FOR RADIATIVE TRANSFER IN HETEROGENEOUS THREE-DIMENSIONAL CANOPIES
NARENDRA S. GOEL and TOBY GRIER (New York, State University, Binghamton) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 255-293. NASA-supported research. refs

A model for radiative transfer in heterogeneous three-dimensional canopies such as those found in forests is proposed. Its use in estimating important biophysical variables such as leaf area index and canopy architecture from bidirectional canopy reflectance data is discussed. The model and its use in estimating canopy parameters through its inversion are validated with measured canopy reflectance data for corn canopies. Author

A88-50283
A SOIL-ADJUSTED VEGETATION INDEX (SAVI)
A. R. HUETE (Arizona, University, Tucson) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 295-309. refs

A transformation technique is presented to minimize soil brightness influences from spectral vegetation indices involving red and near-infrared (NIR) wavelengths. Graphically, the transformation involves a shifting of the origin of reflectance spectra plotted in NIR-red wavelength space to account for first-order soil-vegetation interactions and differential red and NIR flux extinction through vegetated canopies. For cotton (Gossypium hirsutum L. var DPL-70) and range grass (Eragrostis lehmanniana Nees) canopies, underlain with different soil backgrounds, the transformation nearly eliminated soil-induced variations in vegetation indices. A physical basis for the soil-adjusted vegetation

index (SAVI) is subsequently presented. The SAVI was found to be an important step toward the establishment of simple 'global' models that can describe dynamic soil-vegetation systems from remotely sensed data. Author

A88-50286
MONITORING GRASSLAND DRYNESS AND FIRE POTENTIAL IN AUSTRALIA WITH NOAA/AVHRR DATA
G. W. PALTRIDGE (CSIRO, Div. of Atmospheric Research, Melbourne, Australia) and J. BARBER (Country Fire Authority, Melbourne, Australia) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 381-394. refs

Results of an extensive experiment at five sites in Victoria, Australia, during the 1985-1986 summer are presented, and a modified vegetation index observed by the AVHRR is related to 'grassland' fuel-moisture content. This relation is used as a basis for an operational system by which the Country Fire Authority uses AVHRR imagery as an objective input to decisions on the declaration of total fire ban regions in Victoria. Author

A88-50716
REMOTE SENSING OF SOIL MOISTURE USING MICROWAVE RADIOMETRY - PROBLEMS, SOLUTIONS, AND IMPLEMENTATION IN THE NATIONAL ECONOMY [DISTANTSIONNOE OPREDELENIE VLAZHNOSTNYKH SVOISTV ZEMNYKH POKROVOV RADIOLOKATSIONNYMI SREDSTVAMI - PROBLEMY, RESHENIIA, ISPOL'ZOVANIE V NARODNOM KHOZIAISTVE]
N. A. ARMAND and A. M. SHUTKO IN: Problems in contemporary radio engineering and electronics. Moscow, Izdatel'stvo Nauka, 1987, p. 118-131. In Russian. refs

A88-52427#
USE OF AVHRR DATA IN AN INFORMATION SYSTEM FOR FIRE MANAGEMENT IN THE WESTERN UNITED STATES
W. A. MILLER, D. G. MOORE (USGS, EROS Data Center, Sioux Falls, SD), and S. M. HOWARD (TGS Technology, Inc.; USGS, EROS Data Center, Sioux Falls, SD) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 67-79. refs
(Contract USGS-14-08-0001-20129)

A fire fuel-type map of 42 million acres in eastern Oregon was prepared using multitemporal analysis of AVHRR data. AVHRR spectral data, acquired on four dates, were registered to a digital data base that also included elevation, slope, aspect, and roads. The fuel-type data layer was derived by using unsupervised classification of AVHRR spectral data and post-classification labeling based on field knowledge and terrain data. The overall classification accuracy of a 6.4-million acre subset of this data layer (Malheur County) was 92 percent. In northwestern Arizona, the Bureau of Land Management has found time-series analysis of AVHRR data useful for monitoring the spring growth patterns of green herbaceous vegetation and estimating the beginning of senescence of the annual grasses. Author

A88-52428#
A TIMELY RESPONSE FOR INFORMATION NEEDS IN SUDAN
B. SPIERS, K. HALEY, F. DAVID (USDA, Foreign Agricultural Service, Washington, DC), W. TRAYFORS, and J. OLSSON (U.S. Agency for International Development, Africa Bureau, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 81-85.

The purpose of this paper is to describe how the Foreign Agricultural Service (FAS), Foreign Crop Condition Assessment Division (FCCAD) arrived at an estimate of the 1985 sorghum and millet cropped area for the eastern Sudan using Landsat Multispectral Scanner Data (MSS). This crop estimation project was begun in early October 1985 at the request of the Africa Bureau, United States Agency for International Development with final results reported to Sudanese and USAID-Khartoum officials in mid-December. Author

A88-52432#
REMOTE SENSING COMBINED WITH ANCILLARY DATA FOR LAND DEGRADATION STUDIES IN CENTRAL SUDAN
EVA AHLCRONA (Lund, Universitet, Sweden) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 127-141. Research sponsored by the Swedish Agency for Research Cooperation with Developing Countries. refs

Landsat data and air photos are used to study land tranformations, changes in rainfall, and changes in vegetation in central Sudan between 1961-1983. The relationship between crop yield and rainfall is examined. Changes in the vegetation composition were investigated through interviews in 57 villages in the region. No large shifts in land systems borders, transgression of the cultivation limit, systematic growth of village perimeters, or strong short-period oscillations of rainfall were observed. It was found that 50 to 70 percent of the variation in crop yield could be explained by rainfall parameters. Although no definite pattern of land degradation could be established using the remotely sensed data, a change in the vegetation toward poorer grazing quality is shown to exist. R.B.

A88-52433*# Food and Agriculture Organization of the United Nations, Rome (Italy).
THE FAO/NASA/NLR ARTEMIS SYSTEM - AN INTEGRATED CONCEPT FOR ENVIRONMENTAL MONITORING BY SATELLITE IN SUPPORT OF FOOD/FEED SECURITY AND DESERT LOCUST SURVEILLANCE
J. U. HIELKEMA, J. A. HOWARD (UN, Food and Agriculture Organization, Rome, Italy), C. J. TUCKER (NASA, Goddard Space Flight Center, Greenbelt, MD), and H. A. VAN INGEN SCHENAU (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 147-160. refs

The African real time environmental monitoring using imaging satellites (Artemis) system, which should monitor precipitation and vegetation conditions on a continental scale, is presented. The hardware and software characteristics of the system are illustrated and the Artemis databases are outlined. Plans for the system include the use of hourly digital Meteosat data and daily NOAA/AVHRR data to study environmental conditions. Planned mapping activities include monthly rainfall anomaly maps, normalized difference vegetation index maps for ten day and monthly periods with a spatial resolution of 7.6 km, ten day crop/rangeland moisture availability maps, and desert locust potential breeding activity factor maps for a plague prevention program. R.B.

A88-52434#
AFRICAN FAMINE AND EARLY WARNING - EAST AFRICAN REGIONAL PROGRAMMES
HASSAN M. HASSAN and ALLAN FALCONER (Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 161-164.

The Regional Center for Services in Surveying, Mapping and Remote Sensing, offers short-courses, on-the-job training, user assistance in data preparation and interpretation for scientists wishing to use remote sensing techniques. The Center also offers support in the design and implementation of projects and is currently involved in the execution of a crop prediction and agricultural statistics program in Sudan. The Center is also working with FAO in the preparation of a regional food security and early warning system for East Africa and with World Bank in the

preparation of a training and demonstration project for computer based systems for natural resources data management. Author

A88-52435#
REMOTE SENSING AND AGRICULTURAL STATISTICS
LEON OKIO and FRAN RIBOT (Regional Remote Sensing Centre, Ouagadougou, Burkina Faso) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 165-175.

The need to establish an early warning system in West Africa to combat natural disasters (locust, drought) is well known. This system encompasses the gathering of agricultural statistics and crop forecasting data where remote sensing techniques cannot be disassociated. The first course on remote sensing application to agricultural statistics conducted at the CRTO prepared scientists and technicians to utilize this technology. Furthermore, the course underlined the need to conduct further research in this field which is still inadequately used in Africa. Author

A88-52443#
FAO REMOTE SENSING ACTIVITIES RELEVANT TO AGRICULTURE AND FOOD SECURITY IN AFRICA
JOHN A. HOWARD and VICTOR A. O. ODENYO (UN, Food and Agriculture Organization, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 269-285. refs

Remote sensing programs by the FAO in Africa are reviewed, including applications in land resources, soils, water resources, pasture and rangeland management, forestry, fisheries, and monitoring rural disasters. Techniques used in these areas include side-looking airborne radar, Landsat MSS, Landsat TM, SPOT, digital interactive analysis systems, and NOAA AVHRR and Meteosat. The historical development of these programs, and training programs in remote sensing applications are also examined. R.B.

A88-52444#
AGRIT-PROGRAM - THE OPERATION USE OF REMOTE SENSING FOR WHEAT AND CORN PRODUCTION FORECASTING AT NATIONAL LEVEL
FRANCESCO ASCANI (Ministero dell'Agricoltura e delle Foreste, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 287-292. refs

The results of Italian studies of the agricultural applications of remote sensing techniques are presented. Landsat MSS and TM data and NOAA/AVHRR data were used to forecast corn and wheat production, to determine total biomass and leaf area index, and to prepare sample reference maps for crop inventories and production forecasts. The economic aspects of remote sensing applications are considered and a cost/benefit analysis is presented. R.B.

A88-52445#
MULTI-SCALE STUDIES IN AGRICULTURAL LAND USE AND CROP ESTIMATION - A PILOT STUDY IN APPLICATIONS OF SATELLITE IMAGERY IN ZIMBABWE
A. T. PILIME and R. MUTANDI (Department of Agricultural Technical and Extension Services, Harare, Zimbabwe) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 293-317. refs

The aim within sub-project 2 has been to use satellite imagery (Thematic Mapper data used this far, SPOT data on order) for land use survey and crop estimation. The approach is multi-stage. Objectives have been the production of maps and tabular data showing generalized land use and land potential, refining down to a closer look at cropped land, then crops (maize, seasonal fallow and other crops). Late and early plantings are to be distinguished. Interim findings indicate that satellite imagery will speed up the survey of land use and land potential at the semi-detailed scale. Cropped land can be extracted and mapped. We cannot conclude yet on the crop estimation. The preponderance of maize and its distribution within each sample 5-hectare area points to possibilities of reasonable accuracy of classification by computer. The landscape approach is used for a statistical as well as land unit distributive answer on cropping, usable by extension personnel. Author

A88-52446#
THE USE OF REMOTE SENSING IN MAIZE PRODUCTION ESTIMATION IN KENYA
W. K. OTTICHILO and D. G. PEDEN (Kenya Rangeland Ecological Monitoring Unit, Nairobi) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 319-324. refs

Following the 1984 drought, the Kenya Rangeland Ecological Monitoring Unit developed a procedure that forecasts preharvest maize production using aerial photography to estimate the area planted, and radiometry to estimate yields. The ratio of NIR to red reflecting from maize fields was measured with airborne digital radiometers. A regression predicting actual yield from NIR was obtained. A systematic radiometric survey was conducted and the regression was used to estimate preharvest in all maize-growing strata. The procedure developed has been used to estimate the first and second nation-wide maize production in Kenya for the years 1985 and 1986 and has been found to be rapid, cost-effective and reliable. Author

A88-52447#
RANGELAND MONITORING IN KENYA - THE MARA ECOSYSTEM CASE STUDY
D. K. ANDERE (Kenya Rangeland Ecological Monitoring Unit, Nairobi) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 325-345. refs

The paper presents the historical aspects of rangeland practice in Eastern Africa and narrows down to Kenya with the Mara ecosystem as a case study. The Kenya Rangeland Ecological Monitoring Unit was established with a mandate of conducting a nationwide systematic rangeland monitoring in 1975; and to develop a data bank as inputs to planning and management of renewable resources in Kenya. The Mara ecosystem has been selected to demonstrate the techniques involved in rangeland monitoring, data analysis and the Research and Development component of rangeland ecological monitoring. The Mara ecosystem presents a unique study area where there are gradual interactions among various ecological and human factors which have generated some concerns in the future planning and management of the area; hence the value of ecological monitoring. Author

A88-52448#
THE ROLE OF REMOTE SENSING FOR GLOBAL FOREST INVENTORY
K. D. SINGH, P. REICHERT, and R. BALTAXE (UN, Food and Agriculture Organization, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 347-361. refs

The global forest inventories conducted by the FAO are discussed, focusing on the application of remote sensing techniques. The information in the inventories is organized in three levels: broad forest cover and land use, forest type, and management classes. The inventory used Landsat MSS data acquired between 1972 and 1976. Aspects of the inventory include the use of remote sensing for vegetation cover mapping in Benin, Togo, and Southern Cameroon, determining changes in global forest cover, and the stratification of various countries into ecofloristic zones. Characteristics of Landsat MSS and TM and SPOT MSS data are presented, stressing the application of these

systems to the study of forest cover. Also, the potential role of NOAA/AVHRR and microwave data for global forest assessments is considered. R.B.

A88-52449*# National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.
THE USE OF REMOTELY SENSED DATA FOR THE MONITORING OF FOREST CHANGE IN TROPICAL AREAS
ARMOND T. JOYCE and STEVEN A. SADER (NASA, Earth Resources Laboratory, Bay Saint Louis, MS) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 363-378. refs

This paper provides an overview of the use of several remote sensing systems for monitoring changes in tropical forests. Particular attention is given to the use of data from the AVHRR sensors on the NOAA series of satellites, the Landsat MSS and TM, and aircraft and spacecraft acquired Synthetic Aperture Radar. Multisensor and multistage approaches to monitoring change in tropical forests is examined. Forest change monitoring through a geographic information system (GIS) approach is addressed. Finally some suggestions are made for research addressing forest change monitoring in tropical areas. Author

A88-52450#
A CASE STUDY CONCERNING THE TROPICAL FOREST OF KAKAMEGA-NANDI IN WEST KENYA [UN CAS D'ETUDE - LA FORET TROPICALE DE KAKAMEGA-NANDI OUEST-KENYA]
J. P. DELSOL, P. MAUREL, and N. OCHANDA (Kenya Rangeland Ecological Monitoring Unit, Nairobi) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 379-393. In French. refs

Topographic maps, forestry maps, 1:10,000-scale aerial photographs, and Landsat images are used to study the tropical forest of the Kakamega-Nandi region of West Kenya for the eight and a half year period between 1972 and 1979. A general description of the forest ecosystem of the region is first presented. The Landsat data reduction procedure is described. The present data are used to inventory surface vegetation types and to evaluate the effect of vegetation changes on agriculture. The results indicate a deforestation rate of 1 percent per year for the entire Kakamega-Nandi region. It is pointed out that, although suitable for rough determinations, the Landsat images cannot distinguish between such features as hardwood forests and semidense forests. R.R.

A88-52451#
TWO WORLDS MEET SATELLITE-BASED WILDLIFE TRACKING
MICHEL TAILLADE (CNES, Service ARGOS, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 395-402.

ARGOS went operational as a worldwide data collection and location system in 1979. It is based on a program of cooperation between NOAA (National Oceanic and Atmospheric Administration) and CNES (Centre National d'Etudes Spatiales), the French Space Agency. Satellite wildlife tracking has expanded rapidly in many countries over the last 12 months (1986), and tracking includes turtles, as well as polar bears, elephants, and eagles. Author

A88-52458#
REMOTE SENSING AND MAPPING OF THE VEGETATION AND LAND USE OF SENEGAL
G. TAPPAN (South Dakota State University, Brookings) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 483-488.

A series of vegetation cover and land use maps has been completed for Senegal. The methodology used in preparing the maps is examined. A multistage and multitemporal approach was used to integrate Landsat imagery at 1:250,000 scale, extensive field surveys, and aerial photographs. The final maps depicted over 160 vegetation types and 50 different land uses and cover types at 1:500,000 scale. R.B.

A88-52462#
ESTIMATING THE EXTENT OF DROUGHT IN ETHIOPIA USING AVHRR DATA
B. L. HENRICKSEN and J. W. DURKIN (International Livestock Centre for Africa, Addis Ababa, Ethiopia) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 521-533. refs

A88-52464#
QUANTITATIVE DESCRIPTION OF BARE SOILS PATTERNS IN THE WEST AFRICAN SAHEL
C. MERING, Y. PONCET, C. JACQUEMINET, and M. RAKOTO-RAVALONTSALAMA (Office de la Recherche Scientifique et Technique d'Outre-Mer, Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 555-566.

A88-52484#
AGRICULTURAL INVESTIGATIONS WITHIN AN INFORMATION SYSTEMS CONTEXT FOR THE REGION OF THE VENETO, ITALY
J. ESTES, J. STAR, M. CASWELL, D. GRICE, C. SCHMULLIUS (California, University, Santa Barbara) et al. IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 845-858. refs

The development of the procedures for using Landsat TM and other satellite data for agricultural applications in the Veneto region of Italy is examined. The tasks of the program are geographic information systems development, crop types determination, yield estimation, and econometric and hydrologic modeling. The research area and the approaches used in the study are discussed. The interaction between the economic models and the remotely sensed and ancillary data is stressed. R.B.

A88-52485#
ASSESSMENT AND MAPPING OF DESERTIFICATION IN RAJASTHAN (INDIA) USING SATELLITE PRODUCTS
S. S. DHABRIYA (Birla Institute of Scientific Research, Jaipur, India) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 859-868. refs

A88-52486#
REMOTE SENSING IMAGERY FOR THE DETECTION OF STRESS IN VEGETATION CAUSED BY DROUGHT AND/OR METAL TOXICITY
M. M. COLE, M. E. FARAGO, A. MEHRA, and P. VUJAKOVIC (Royal Holloway and Bedford New College, Egham, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 889-898. refs

The use of Landsat MSS and TM, SPOT, and Daedalus scanner imagery for monitoring vegetation changes related to drought and metal toxicity in Botswana, the UK, and South Africa is discussed. It is found that toxic conditions are manifest in changes in the form and composition of vegetation and in biogeochemical

differences affecting reflectance. It is shown that large geobotanical anomalies confined to the ground layer can be identified by remote sensing if the tree canopy is sufficiently open and if uptake of a toxic element by the trees causes contrasts in reflectance. The types and sizes of anomalies which can be detected by remotely sensed imagery are outlined. R.B.

A88-52500#
DROUGHT MONITORING WITH NOAA AVHRR AND LANDSAT MSS DATA IN SOUTHERN SASKATCHEWAN, CANADA
H. EPP (Canada Centre for Remote Sensing, Ottawa) and J. POLSON (Saskatchevan Research Council, Saskatoon, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1045-1050.

A88-52502#
USE OF LANDSAT THEMATIC MAPPER IMAGERY FOR SOIL AND LANDUSE INVESTIGATIONS IN PARAIBA, BRAZIL
K. A. ULBRICHT (DFVLR, Institut fuer Optoelektronik, Wessling, Federal Republic of Germany) and H. S. TEOTIA (Paraiba, Universidade Federal, Areia, Brazil) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1059-1070. refs

A88-52503#
MULTISTAGE BIOMASS ENERGY MAPPING AND INVENTORY SYSTEM
JOSEPH D. KASILE (Ohio State University, Columbus) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1071-1080.

A three-stage energy biomass mapping and inventory system was completed for the State of Ohio and also tested in the Dominican Republic. Landsat data was used as the primary stratifier. The second stage sampling was the photo-interpretation of randomly selected one kilometer grid squares that exactly corresponded to the Landsat one kilometer grid square classification orientation. Field sampling comprised the third stage of the energy biomass inventory system and was used to assign British Thermal Unit (BTU) values to the photointerpretation and to adjust the Landsat classification. The product is a set of maps and an inventory of energy biomass resources to a one kilometer grid square basis on the Universal Transverse Mercator (UTM) system. Each square kilometer is identified and mapped showing total BTU energy availability and transportation accessibility. Land cover percentages and BTU values are provided for each of nine biomass strata types for each one kilometer grid square. The sampling error for the whole system was 3.91 percent, providing a high degree of reliability to the energy values. Author

A88-52504#
SOME PROBLEMS CONNECTED WITH WHEAT PRODUCTION FORECASTING BY USING REMOTE SENSED DATA IN REAL-TIME EXPERIMENTS
RAFFAELLA ALESSANDRI (Telespazio S.p.A., Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1081-1084.

From 1980, Consortium ITA, made up of TELESPAZIO (IRI-STET), AQUATER (ENI), ITALECO (ITALSTAT), is involved in wheat production forecasting projects, financially supported by the Italian Ministry of Agriculture and Forestry. During the first four years a methodology to achieve wheat production forecasting in Italian provinces was developed. In 1985, Consortium ITA has carried on the AGRIT-1 project, which was the first to supply wheat production forecasting in 'real-time', that is, a few days after satellite passage over the test areas, before harvest. This paper describes the problems connected with such experiments and those expected by considering wider areas. Author

A88-52505#
EVALUATING THE DOWNSTREAM IMPACTS OF DAM CONSTRUCTION ON AGRICULTURAL LAND USE/COVER USING MULTITEMPORAL LANDSAT MSS DATA - A STUDY OF THE BAKOLORI IRRIGATION PROJECT, NIGERIA
PAUL G. PILON (Waterloo, University, Canada) and P. O. ADENIYI (Lagos, University, Nigeria) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1085-1094. Research supported by the International Development Research Center and NSERC. refs

A88-52506#
SPECTRAL RESPONSE ON DIFFERENT GROWING STAGES AND FINAL WINTER YIELDS IN TRENQUE LAUQUEN, ARGENTINA
M. C. SERAFINI (Comision Nacional de Investigaciones Espaciales, Centro Espacial de Sensores Remotos, Buenos Aires, Argentina) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1095-1103. refs

The relationship between the spectral response of winter wheat in different phenological stages and final yields is analyzed to determine the optimum Landsat acquisition dates for crop assessments. The study, which was conducted in Argentina in the 1980-1983 growing seasons, used Landsat MSS data for the tillering, full flowering, and end of flowering/grain filling stages of growth. The transformed vegetation indices 6 and 7, the green vegetation index, and the difference vegetation index were used. A linear relationship between yields and band ratios and vegetation indices is found. The best correlations were found during the flowering stage and the end of flowering/grain filling stage. R.B.

A88-52507#
LANDSAT 2 MSS-FCC ANALYSES OF POTENTIAL AREAS FOR RICE AND FISHERY DEVELOPMENT IN THE ONCHO-FREED WHITE VOLTA BASIN IN THE NORTH OF GHANA
E. AMAMOO-OTCHERE (ECA Regional Centre for Training in Aerial Surveys, Ile-Ife, Nigeria) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1105-1118. refs

A88-52508#
REMOTE SENSING AS AN AID FOR AREA ESTIMATION OF RAINFED CROPS IN SAHELIAN COUNTRIES
E. BARTHOLOME (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1119-1128.

Experiments to test a method applying remote sensing techniques to the estimation of rainfed crops were conducted in Mali in 1986. Data for the study included Landsat MSS and SPOT imagery, air-photos, and field observations. The study concentrated on three spatial levels: the agricultural region, the land-facets, and the fields. The use of remote sensing for regional delineation, estimation of the surface devoted to civilization, and analysis of the various spatial levels is examined. Preliminary results of data analysis are considered. R.B.

A88-52510#
AGRICULTURAL STATISTICS AND SPACE IMAGES IN MADAGASCAR - ESTIMATION OF SECOND RICE SEASON ACREAGE IN A SUB-PREFECTURE
H. ANDRIANASOLO (Office de la Recherche Scientifique et Technique d'Outre-Mer, Institut Francais de Recherche Scientifique

pour le Developpement en Cooperation, Bondy, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1143-1146. refs

The use of remote sensing for estimating rice acreage in Madagascar is discussed. The methods used to select representative images and dates are presented. The processes of stratification and classification and the construction of parameters for rice recognition are examined. The equations for determining the proportion of rice per pixel and to calculate the extension of each stratum are given. The study resulted in a 4 percent overestimation. It is concluded that an increase of resolution, by using SPOT or Landsat TM, could improve the estimation capabilities. R.B.

A88-52511#
DISCRETE SOIL LINE ANALYSIS FOR VEGETATION MAPPING OF THE COASTAL TRACT OF NORTHERN EGYPT
T. S. RICHARDS (Bristol, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1147-1156. refs

Landsat MSS data of the coastal tract of northern Egypt have been used with collateral soils information to produce a Perpendicular Vegetation Index map of the region. In addition to establishing a global soil line for the whole study area, individual soil lines were assessed for eight of the regions. Where appropriate, the individual, or discrete, soil lines have been used to perform the PVI transformation with a view to improve the detectability of low levels of green vegetation cover. Three out of the eight soil types assessed, exhibited sufficiently correlated soil lines to spatially stratify the data in terms of soil type and to produce PVI estimates based upon the three individual soil lines and the aggregate. Author

A88-52514#
REMOTE SENSING OF VEGETATED FRACTION IN AFRICA
ERNESTINE CARY (Cook College, New Brunswick, NJ) and CYNTHIA ROSENZWEIG (Columbia University, New York) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1181-1190. refs

The fraction of land surface covered (i.e., shaded) by vegetation (FV) is a useful indicator for environmental and desertification monitoring. It is also an input to land-surface models which calculate latent and sensible heat fluxes. FV is determined from remotely sensed data for a study site in western Kenya, an area for which ground observations, aerial photographs, and satellite (Landsat and AVHRR) data are available. FV is derived from both Landsat and AVHRR data and the results are evaluated. The effects of variation in FV on soil moisture and other components of the hydrological cycle are determined with a ground hydrology model (GHM) for two general circulation model (GCM) gridboxes in Africa, one with desert vegetation and one with mixed grassland and trees. Author

A88-52515#
CROP AND SUMMERFALLOW AREA ESTIMATION IN SASKATCHEWAN USING LANDSAT MSS DATA
R. DOBBINS (Statistics Canada, Agriculture/Natural Resources Div., Ottawa) and H. EPP (Canada Centre for Remote Sensing, Ottawa) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1191-1200. refs

A88-52517#
SURFACE WATER AND AGRICULTURAL AREA ASSESSMENTS IN OASES OF THE EGYPTIAN WESTERN DESERT USING DIGITALLY PROCESSED LANDSAT-MSS DATA
H. Z. ABOUL EID, A. S. AYOUB, and M. A. ABDEL HADY (Academy of Scientific Research and Technology, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1211-1213.

A88-52518#
REMOTE SENSING OF NATURAL RESOURCES IN ZIMBABWE - WOODLAND COVER MONITORING IN THE COMMUNAL LANDS
F. K. ODOOM (Forestry Commission, Bulawayo, Zimbabwe) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1215-1219. refs

As a component of an ongoing FAO project in Zimbabwe on technical assistance in remote sensing applications for agricultural and forestry land use inventory and rural disaster monitoring, the assessment of changes in forested land was proposed. Three test areas were chosen to fall within selected communal lands of the country. The communal lands were chosen due to the serious nature of the state of denudation of most of them. The background to this state of denudation is given. An assessment of changes in woodland areas in two of the test areas by analogue interpretation of Landsat MSS imageries is described. Proposals have also been made with regards to future monitoring of the vegetation cover of all the communal lands in the country by digital change detection techniques using satellite data. Author

A88-52519#
ROUTINE PRODUCTION OF CROP AND DROUGHT MONITORING PRODUCTS FROM NOAA-AVHRR DATA
N. A. PROUT, G. J. WESSELS (Intera Technologies, Ltd., Ottawa, Canada), G. K. WALKER (Canadian Wheat Board, Winnipeg, Canada), and R. J. BROWN (Canada Centre for Remote Sensing, Ottawa) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1221-1230. refs

The process for extracting vegetation indices from NOAA-AVHRR data are discussed and a study using these data for agricultural drought forecasting in Western Canada is presented. Radiometric and geometric corrections are applied to 1.1 km resolution data in the visible and near-IR channel in order to extract vegetation indices. The study used data from 1983 and 1985 to show that sites impacted by drought and experiencing lower yields exhibit lower indices. R.B.

A88-52522*# California Univ., Santa Barbara.
CANOPY REFLECTANCE MODELING IN SAHELIAN AND SUDANIAN WOODLAND AND SAVANNAH
JANET FRANKLIN (California, University, Santa Barbara), XIAOWEN LI, and ALAN H. STRAHLER (Hunter College, New York) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1273-1282. refs
(Contract NAGW-788; NGT-05-010-804)

A88-52523#
AUTOMATED TIMBER STAND MAPPING FOR STRATIFIED GROUND SAMPLING
J. S. LEVITAN and H. L. BOWLIN (USDA, Forest Service, San Francisco, CA) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1283-1292. refs

Estimates of commercial timber volumes and other timber stand attributes were made on two National Forests in California, U.S.A. using Landsat-3 imagery to do vegetation type mapping. Timber strata based on this mapping were the basis for a stratified sample of ground plots on which tree attributes were measured. Volume, growth and other estimates resulted from these inventories. Error terms are in line with expected results from conventional phototyping stratification methods. Author

A88-52524#
MONITORING FOREST DEPLETION IN WESTERN KENYA WITH DIGITAL MOMS-01 DATA
H. EPP (Canada Centre for Remote Sensing, Ottawa) and R. SINANGE KIMANGA (Kenya Rangeland Ecological Monitoring Unit, Nairobi) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1293-1297. refs

A88-52525#
THEMATIC MAPPER IN TROPICAL FOREST INVENTORIES - A COMPARISON WITH LANDSAT MSS DATA, PANCHROMATIC AERIAL PHOTOGRAPHY AND COLOUR INFRARED AERIAL PHOTOGRAPHY
S. EKSTRAND (Swedish Space Corp., Stockholm, Sweden) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1299-1307. refs

A88-52526*# TGS Technology, Inc., Moffett Field, Calif.
TEMPORAL TRENDS IN EARTH-ATMOSPHERE SYSTEM REFLECTANCE FACTOR FOR SAGEBRUSH STEPPE VEGETATION COMMUNITIES
LAURENCE L. STRONG (TGS Technology, Inc., Moffett Field, CA) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1309-1318. NASA-supported research. refs

Four consecutive Landsat-5 Thematic Mapper acquisitions were used to examine trends in earth-atmosphere system reflectance factors of sagebrush steppe vegetation communities following soil moisture recharge from snow melt. Significant differences in trends between vegetation communities correspond to known differences in the initiation and duration of active vegetation growth. Information on short-term vegetation processes are a valuable supplement to estimates of total vegetation cover which can be obtained using satellite brightness images at less frequent temporal intervals. Author

A88-52527#
RANGE INVENTORY AND EVALUATION FOR DOMESTIC LIVESTOCK AND WILDLIFE - A CASE STUDY IN MALI, AROUND DJOUMARA (KAARTA)
N. A. SOW (CRTO, Ouagadougou, Burkina Faso) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1319-1330. refs

A88-52528#
A STEP TOWARDS FUELWOOD POTENTIAL ASSESSMENT WITH LANDSAT
F. K. ODOOM and J. G. JUDGE IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1331-1337. refs

A study using Landsat imagery to assess areas for fuelwood supply and to determine theoretical plantation areas to meet fuelwood deficits in Zimbabwe is presented. For the study, six Landsat images were used covering 2,500,000 ha of land during August 1976. Monoscopic interpretation of false color composite prints at the scale of 1:1,000,000 was conducted. The method for assessing the potential supply of fuelwood is discussed and tables of the data are given. The advantages of employing Landsat imagery are considered. R.B.

A88-52533*# National Air and Space Museum, Washington, D.C.
REMOTE SENSING AND FIELD STUDY OF DROUGHT-RELATED CHANGES IN THE INLAND NIGER DELTA OF MALI
P. A. JACOBBERGER (National Air and Space Museum, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1379-1385. Research supported by the Smithsonian Institution. refs
(Contract NAS5-28774)

A88-52545#
MONITORING OF NATURAL RENEWABLE RESOURCES AND CROPS FORECASTING IN SAHELIAN COUNTRIES BY REMOTE SENSING [SURVEILLANCE DES RESSOURCES NATURELLES RENOUVELABLES ET PREVISION DES RECOLTES PAR TELEDETECTION]
EMILIO BARISANO (Societe d'Etudes Techniques et d'Entreprises Generales, Valbonne, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1495-1502. In French.

SODETEG Remote Sensing Center, a french private company, was in charge of an operational methodologic realization using Remote Sensing for crops forecasting in Sahelian countries. This project includes CILSS (1) Regional Program - 'Monitoring of Natural Renewable Resources and Crops Forecasting in Sahelian Countries by Remote Sensing', funded by the FED (2). Author

A88-52871
SPECTRAL REFLECTANCE OF HIGHER AQUATIC PLANTS [SPEKTRAL'NAIA OTRAZHATEL'NAIA SPOSOBNOST' VYSSHEI VODNOI RASTITEL'NOSTI]
K. IA. KONDRAT'EV and V. B. NEBESNYI (AN SSSR, Institut Ozerovedeniia, Leningrad, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 301, no. 1, 1988, p. 249-252. In Russian.

The spectral reflectance coefficients (SRCs) of reed and sedge specimens obtained, together with the soil slabs, from several regions of the Dnepr delta were measured, and the reflectance characteristics of various plant organs, such as the panicle, leaves, and the stem, were compared. It was found that, while the shape of the spectral-reflectance curves of all reed and sedge specimens was similar, the spectral reflectance characteristics of different plant organs of a given plant differed not only in the values of their SRCs at different wavelengths, but also in the spectral content of the reflected light. These results were applied in a field study of reed cover determinations, and, using the results of this field study, an equation was derived for the determination of the reed phytomass by airborne measurements. V.L.

A88-53028* New Hampshire Univ., Durham.
DETECTION OF FOREST CHANGE IN THE GREEN MOUNTAINS OF VERMONT USING MULTISPECTRAL SCANNER DATA
JAMES E. VOGELMANN (New Hampshire, University, Durham) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1187-1200. NASA-supported research. refs

A88-53029
THE ASSESSMENT AND MONITORING OF SPARSELY VEGETATED RANGELANDS USING CALIBRATED LANDSAT DATA
R. D. GRAETZ, R. P. PECH (CSIRO, Div. of Wildlife and Rangelands Research, Lyneham, Australia), and A. W. DAVIS (CSIRO, Div. of Mathematics and Statistics, Glen Osmond, Australia) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1201-1222. refs

Measurements of the cover of vegetation were obtained at a network of 58 30-ha sites within a semiarid rangeland in southern Australia in order to calibrate Landsat data and produce maps of the living and nonliving plant material. The regression equations included only MSS band-5 data. Images were used to assess and monitor the behavior of pastoral properties and the changes occurring in five individual rangeland types over the 1981-1984 period, which included a severe drought in 1982-1983. Although drought conditions produced a universal decline in vegetation cover levels, the size of the decline was found to be specific to rangeland type. R.R.

A88-53030* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONTINENTAL SCALE VARIABILITY IN VEGETATION REFLECTANCE AND ITS RELATIONSHIP TO CANOPY MORPHOLOGY
D. S. BARTLETT, R. W. JOHNSON (NASA, Langley Research Center, Hampton, VA), M. A. HARDISKY (Scranton, University, PA), M. F. GROSS, V. KLEMAS (Delaware, University, Newark) et al. International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1223-1241. NASA-supported research. refs

The spectral canopy reflectance, biomass, and projected leaf-area index (LAI) of widely dispersed plots of a North American coastal plant were measured in order to study potential impacts of continental-scale environmental variability on the assumptions underlying remote vegetation analysis. Systematic changes in the canopy geometry and resultant near-infrared reflectance of this plant were noted. Mean infrared canopy reflectances of canopies in the northern half of the range were shown to nearly double those of the southern half. It is suggested that the difference results from divergent canopy morphologies, with the northern canopies presenting greater horizontally projected LAIs per unit biomass than southern canopies. R.R.

A88-53031* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SELECTING A SPATIAL RESOLUTION FOR ESTIMATION OF PER-FIELD GREEN LEAF AREA INDEX
PAUL J. CURRAN (NASA, Ames Research Center, Moffett Field, CA; Sheffield, University, England) and H. DAWN WILLIAMSON (Adelaide, University, Australia) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1243-1250. refs
(Contract NERC-GR/3/5096)

For any application of multispectral scanner (MSS) data, a user is faced with a number of choices concerning the characteristics of the data; one of these is their spatial resolution. A pilot study was undertaken to determine the spatial resolution that would be optimal for the per-field estimation of green leaf area index (GLAI) in grassland. By reference to empirically-derived data from three areas of grassland, the suitable spatial resolution was hypothesized to lie in the lower portion of a 2-18 m range. To estimate per-field GLAI, airborne MSS data were collected at spatial resolutions of 2 m, 5 m and 10 m. The highest accuracies of per-field GLAI estimation were achieved using MSS data with spatial resolutions of 2 m and 5 m. Author

A88-53032* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ESTIMATING SOIL WETNESS USING SATELLITE DATA
BHASKAR J. CHOUDHURY (NASA, Goddard Space Flight Center, Greenbelt, MD) and ROBERT E. GOLUS (Science Applications Research, Lanham, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1251-1257.

Improved estimates of soil wetness were obtained using observations from both the NIMBUS-7 Scanning Multichannel Microwave Radiometer (SMMR) and the NOAA-7 Advanced Very High Resolution Radiometer (AVHRR). SMMR 66 GHz frequency, horizontal polarization, brightness temperature T(BH) was first correlated with soil wetness, as computed using an Antecedent Precipitation Index (API) model, for a number of SMMR ground resolution areas involving a fairly wide range of vegetation densities. The API generally accounted for more than 70 percent of the observed temporal variability in T(BH), with linear correlations being significant at the 1 percent level. The regression slope of T(BH) versus API correlated well, at the 1 percent level, with a vegetation index derived from AVHRR visible and near-infrared observations. The regression intercept was found to correlate less satisfactorily, but was significant at the 5 percent level. These linear regression results were used to develop a diagnostic model for soil wetness using SMMR and AVHRR data only. Author

A88-53382* Kansas State Univ., Manhattan.
FINITE ELEMENT DISCRETE ORDINATES METHOD FOR RADIATIVE TRANSFER IN NON-ROTATIONALLY INVARIANT SCATTERING MEDIA - APPLICATION TO THE LEAF CANOPY PROBLEM
RANGA B. MYNENI, EDWARD T. KANEMASU (Kansas State University, Manhattan), and GHASSEM ASRAR (NASA, Washington, DC; Kansas State University, Manhattan) Journal of Quantitative Spectroscopy and Radiative Transfer (ISSN 0022-4073), vol. 40, Aug. 1988, p. 147-155. refs
(Contract NAG5-389)

A finite element discrete ordinates method for solving the radiative transfer equation in nonrotationally invariant scattering media has been applied to the lead-canopy problem, and results are presented on the cross sections and the reflection functions. The method is based on a unique implementation of the Galerkin integral law formulation of the transport equation. For both near-normal and grazing incidences, the transfer functions of leaf canopies are found to be strongly anisotropic, with relatively more scattered flux in the vertical directions. It is suggested that the assumption of isotropic scattering in leaf canopies is not valid. R.R.

A88-53383* Kansas State Univ., Manhattan.
SOLUTION OF AN INTEGRAL EQUATION ENCOUNTERED IN STUDIES ON RADIATIVE TRANSFER IN COMPLETELY ABSORBING LEAF CANOPIES
RANGA B. MYNENI, EDWARD T. KANEMASU (Kansas State University, Manhattan), and GHASSEM ASRAR (NASA, Washington, DC; Kansas State University, Manhattan) Journal of Quantitative Spectroscopy and Radiative Transfer (ISSN 0022-4073), vol. 40, Aug. 1988, p. 157-164. refs
(Contract NAG5-389)

The leaf normal distribution function is related to the extinction coefficient of direct solar radiation by a Fredholm integral equation of the first kind. The integral equation is solved by the method of constrained least squares. The solutions are stable and correct only in extreme cases and, in general, it is not possible to recover an arbitrary leaf normal distribution function. Author

A88-53384* Kansas State Univ., Manhattan.
THE HOT SPOT OF VEGETATION CANOPIES
RANGA B. MYNENI and EDWARD T. KANEMASU (Kansas State University, Manhattan) Journal of Quantitative Spectroscopy and Radiative Transfer (ISSN 0022-4073), vol. 40, Aug. 1988, p. 165-168. refs
(Contract NAG5-389)

A conventional radiometer is used to identify the hot spot (the peak in reflected radiation in the retrosolar direction) of vegetation. A multiwavelength-band radiometer collected radiances on fully grown dense wheat and maize canopies on several clear sunny days. It is noted that the hot spot is difficult to detect in the near IR wavelengths because the shadows are much darker. In general, the retrosolar brightness is found to be higher for smaller sun polar angles than for larger angles. R.R.

A88-53530* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DETECTING AIR POLLUTION STRESS IN SOUTHERN CALIFORNIA VEGETATION USING LANDSAT THEMATIC MAPPER BAND DATA
WALTER E. WESTMAN (NASA, Ames Research Center, Moffett Field, CA) and CURTIS V. PRICE (TGS Technology, Inc., Moffett

Field, CA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Sept. 1988, p. 1305-1311. refs

Landsat Thematic Mapper (TM) and aircraft-borne Thematic Mapper simulator (TMS) data were collected over two areas of natural vegetation in southern California exposed to gradients of pollutant dose, particularly in photochemical oxidants: the coastal sage scrub of the Santa Monica Mountains in the Los Angeles basin, and the yellow pine forests in the southern Sierra Nevada. In both situations, natural variations in canopy closure, with subsequent exposure of understory elements (e.g.,rock or soil, chaparral, grasses, and herbs), were sufficient to cause changes in spectral variation that could obscure differences due to visible foliar injury symptoms observed in the field. TM or TMS data are therefore more likely to be successful in distinguishing pollution injury from background variation when homogeneous communities with closed canopies are subjected to more severe pollution-induced structural and/or compositional change. The present study helps to define the threshold level of vegetative injury detectable by TM data. Author

A88-53678
MICROWAVE POLARIZATION INDEX FOR MONITORING VEGETATION GROWTH
SIMONETTA PALOSCIA and PAOLO PAMPALONI (CNR, Istituto per la Ricerca sulle Onde Elettromagnetiche, Florence, Italy) (IEEE, URSI, NASA, et al., IGARSS '87 - International Geoscience and Remote Sensing Symposium, University of Michigan, Ann Arbor, May 18-21, 1987) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 26, Sept. 1988, p. 617-621. Research supported by the Officine Galileo S.p.A., Segnelamento Marittimo ed Aereo S.p.A., and CNR. refs

It is known that microwave emission from soil is partially polarized, whereas the polarization degree of radiation from crops is either very small or equal to zero. The effect of vegetation on the polarized emission from the soil is analyzed by means of a model based on the radiative transfer theory. A comparison between the values predicted by the model and the experimental data obtained at 10 and 36 GHz shows that the model is particularly adequate for corn at 10 GHz, in which case different values of leaf area index can be estimated. At 36 GHz, the polarization degree changes very rapidly as vegetation grows and it is possible to distinguish only bare soil from vegetated soil. I.E.

A88-53679
SATELLITE MICROWAVE RADIOMETRY OF FOREST AND SURFACE TYPES IN FINLAND
MARTTI T. HALLIKAINEN, JUHA M. HYYPPA (Helsinki University of Technology, Espoo, Finland), and PETRI A. JOLMA (Telenokia, Inc., Espoo, Finland) (IEEE, URSI, NASA, et al., IGARSS '87 - International Geoscience and Remote Sensing Symposium, University of Michigan, Ann Arbor, May 18-21, 1987) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 26, Sept. 1988, p. 622-628. refs

N88-25947# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
STUDY OF EVOLUTION OF VEGETAL COVER AND SLIDE SCARS IN THE CUBATAO MUNICIPALITY-SAO PAULO
CELINA FRANCO BRAGANCA, ELISABETE CRISTINA KONO, LUIZA SAITO JUNQUEIRAAGUIAR, and RONEY PEREZDOS-SANTOS *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 97-113 1987
Avail: NTIS HC A14/MF A01

Atmospheric pollution liberated by the industrial complex of Cubatao acting on the vegetation of the Mogi River valley, in the Serra do Mar, promotes a reduction in the number of higher stratum plants and the decreasing of biomass exposing the Serra do Mar acclivity to the risks of sliding. The objective considers the obtained space-time diagnostics of the occurring degradation in the Cubatao region, which accelerates the function of the erosive processes, with emphasis on slipping. The expansion of soil use is also accompanied by urban and industrial activities. This diagnostic use, basically, aerial photointerpretation, is the most adequate and possible technique for this evaluation. The systematic field work was done just for the 1985 survey. Author

N88-25948# Fundacao de Ciencia, Aplicacoes e Technologia Espaciais, Sao Jose dos Campos (Brazil).
THE IMPACT OF HEMP PRODUCTION ON THE DEVELOPMENT OF THE MUNICIPALITIES OF ARARAS, LEME, SANTA CRUZ DA CONCEICAO AND PIRASSUNUNGA
MARCOS COVRE, CASSIA B. S. VEIGA, MARCIA MORGADO, RENATO DOSSANTOS, RICARDO L. V. RODRIGUES, KLEBER DEFARIA, FRANCISCO JOSE MENDONCA (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil), and FLAVIO GEWANDSZNAJDER *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 114-130 1987
Avail: NTIS HC A14/MF A01

Data from LANDSAT-5 and SPOT-1 satellites were utilized to update soil use in 4 municipalities of Sao Paulo (Araras, Leme, Santa Cruz da Conceicao, and Pirassununga) which were posteriorly compared, the mapping performed in 1978 was studied for the dynamics of land use, with the emphasis on the expansion of hemp cultivation. Also, information on use capacity as well as environmental parameters of the hydrographic network are evaluated. The work shows a large expansion of hemp cultivation in the four municipalities, on the average a 45 percent increase; alternating the use of the land and interferring in environmental equilibrium. The utilization of orbital data in regional analyses was useful in showing the perspectives of remote sensing techniques in these studies. Author

N88-25960*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
USING SPACE PHOTOGRAPHY OF THE EARTH IN THE CLASSROOM: DROUGHT IN AFRICA
MARGARET C. KINSLER Oct. 1986 15 p Submitted for publication Original contains color illustrations
(Contract NAS9-15800)
(NASA-CR-182948; NAS 1.26:182948) Avail: NTIS HC A03/MF A01 CSCL 14E

A script of a classroom presentation based on space photographs of Africa is presented. The intended audience is elementary and secondary school teachers. Photographs of Lake Chad are used to illustrate climatic developments that exemplify the African drought problem. J.P.B.

N88-25961*# California Univ., Santa Barbara. Dept. of Geography.
CANOPY REFLECTANCE MODELING IN A TROPICAL WOODED GRASSLAND Final Report
DAVID SIMONETT 13 Jun. 1988 113 p
(Contract NAGW-788)
(NASA-CR-182981; NAS 1.26:182981) Avail: NTIS HC A06/MF A01 CSCL 02C

The Li-Strahler canopy reflectance model, driven by LANDSAT Thematic Mapper (TM) data, provided regional estimates of tree size and density in two bioclimatic zones in Africa. This model exploits tree geometry in an inversion technique to predict average tree size and density from reflectance data using a few simple patameters measured in the field and in the imagery. Reflectance properties of the trees were measured in the study sites using a pole-mounted radiometer. The measurements showed that the assumptions of the simple Li-Strahler model are reasonable for these woodlands. The field radiometer measurements were used to calculate the normalized difference vegetation index (NDVI), and the integrated NDVI over the canopy was related to crown volume. Predictions of tree size and density from the canopy model were used with allometric equations from the literature to estimate woody biomass and potential foliar biomass for the sites and for the regions. Estimates were compared with independent measurements made in the Sahelian sites, and to typical values from the literature for these regions and for similar woodlands. In order to apply the inversion procedure regionally, an area must

first be stratified into woodland cover classes, and dry-season TM data were used to generate a stratum map of the study areas with reasonable accuracy. The method used was unsupervised classification of multi-data principal components images. Author

N88-25963# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SEPARABILITY OF CULTIVATION THROUGH DIGITAL ANALYSIS OF SPOT AND TM DATA
GETULIO TEIXEIRA BATISTA, SHERRY CHOU CHEN, ANTONIO TEBALDI TARDIN, and JEAN FRANCOIS DALLEMAND May 1988 16 p In PORTUGUESE; ENGLISH summary Presented at the 2nd Latin-American Symposium on Remote Sensing, Bogota, Colombia, 16-20 Nov. 1987
(INPE-4541-PRE/1287) Avail: NTIS HC A03/MF A01

The objective was to evaluate SPOT and TM data for spectral discrimination of coffee, wheat, sugar cane, and pasture in the Northwest of Parana State. The test site comprises a SPOT scene of approximately 60 x 60 km. Fifteen fields were analyzed for each crop. Field information such as variety, planting date, phenological stage, row space, planting direction, percent soil cover was obtained. Wheat was initially considered as two classes according to its growing stage. Data were analyzed using one SPOT scene (5.3 deg off nadir, east viewing) acquired on July 10, 1986 and one TM scene from August 2, 1986. J-M distance was calculated taking into account several classes and band combinations from both SPOT/HRV and LANDSAT-TM. The best TM band combination for crop discrimination was determined. Separability analysis of crops using SPOT and TM images is presented. Author

N88-26710*# Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.
SOURCES OF SCATTERING IN VEGETARIAN AND OTHER SURFACES AND OBJECTS Final Report
R. K. MOORE Jun. 1988 7 p
(Contract NAG5-271)
(NASA-CR-182975; NAS 1.26:182975; RSL-5870-5) Avail: NTIS HC A02/MF A01 CSCL 20N

The sources of scattering in vegetation and other surfaces and objects were studied. A special radar, SOURCESCAT, that could resolve a cylindrical volume 18 cm in diameter and 11 cm long was built. This system provided the first really fine-resolution measurements of radar backscatter from vegetation. The measurements showed that many of the assumptions used previously in modeling vegetation backscatter were false. Vegetation studied included various field crops, prairie grass, and various trees. Major differences were found in the roles of leaves, branches, stems, and trunks for different species. An artificial tree was studied in the laboratory using the systems. The most significant findings were that the average radar volume scattering coefficient is independent of azimuth, and that slanting of the polarization vector can give useful information not available with ordinary vertical and horizontal polarization. A model for scattering from a single leaf was developed. This model, for the first time, took into account the presence of veins in leaves. The pattern of scatter from a leaf was shown quite different from that for which the veins are ignored. A list of publications and presentations resulting from this project are attached. B.G.

N88-26711*# Illinois Natural History Survey, Champaign.
INTERPRETING FOREST BIOME PRODUCTIVITY AND COVER UTILIZING NESTED SCALES OF IMAGE RESOLUTION AND BIOGEOGRAPHICAL ANALYSIS Final Report
LOUIS R. IVERSON, ELIZABETH A. COOK, ROBIN L. GRAHAM, JERRY S. OLSON, THOMAS D. FRANK, and KE YING 15 Jun. 1988 135 p Prepared in cooperation with Oak Ridge National Lab., Tenn.; Global Patterns Associates, Lenoir City, Tenn.; and Illinois Univ., Urbana
(Contract NAS5-28781)
(NASA-CR-183036; NAS 1.26:183036) Avail: NTIS HC A07/MF A01 CSCL 02F

The objective was to relate spectral imagery of varying resolution with ground-based data on forest productivity and cover, and to create models to predict regional estimates of forest productivity and cover with a quantifiable degree of accuracy. A three stage approach was outlined. In the first stage, a model was developed relating forest cover or productivity to TM surface reflectance values (TM/FOREST models). The TM/FOREST models were more accurate when biogeographic information regarding the landscape was either used to stratigy the landscape into more homogeneous units or incorporated directly into the TM/FOREST model. In the second stage, AVHRR/FOREST models that predicted forest cover and productivity on the basis of AVHRR band values were developed. The AVHRR/FOREST models had statistical properties similar to or better than those of the TM/FOREST models. In the third stage, the regional predictions were compared with the independent U.S. Forest Service (USFS) data. To do this regional forest cover and forest productivity maps were created using AVHRR scenes and the AVHRR/FOREST models. From the maps the county values of forest productivity and cover were calculated. It is apparent that the landscape has a strong influence on the success of the approach. An approach of using nested scales of imagery in conjunction with ground-based data can be successful in generating regional estimates of variables that are functionally related to some variable a sensor can detect. B.G.

N88-28352 Bureau of Reclamation, Denver, Colo. Engineering and Research Center.
EVALUATION OF SPOT IMAGERY FOR MONITORING IRRIGATED LANDS
JAMES P. VERDIN, DAVID W. ECKHARDT, and GORDON R. LYFORD (Bureau of Reclamation, Sacramento, Calif.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 81-91 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT were evaluated for monitoring irrigated lands in a midlatitude, high desert environment. Merged 10 and 20-meter data sets were used to prepare 1:24,000 photographic prints, which were found to be suited to delineation of irrigated fields as small as 4 ha. Brightness and greenness transformations for XS data were derived and used for dimensionality reduction prior to performance of a maximum likelihood classification of eight crop cover types. Ninety-one percent accuracy is found after application of a per-field, majority-rule revision. The SPOT data were also used to successfully map chlorophyll concentrations in the reservoir, which serves the irrigation project. ESA

N88-28354 FOMI Remote Sensing Center, Budapest (Hungary).
COMPARATIVE STUDY OF CROP AND SOIL MAPPING USING MULTITEMPORAL AND MULTISPECTRAL SPOT AND LANDSAT DATA
GY. BUETTNER, F. CSILLAG, TAMAS HAJOS, I. JUHASZ, M. KORANDI, G. F. REMETEY, A. SZILAGYI, P. WINKLER, and P. ZILAHY (Research Inst. for Soil Science and Agricultural Chemistry, Budapest, Turkey) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 99-106 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Spring, summer, and autumn SPOT images were analyzed to map crop and soil inhomogeneities on a complex area. Visual comparisons show that SPOT imagery is nearly as interpretable as small or medium scale color infrared (CIR) aerial photography. Based on soil brightness and vegetation index maps derived from spring and summer images, soils with low vegetation cover were enhanced. This simple method reveals spots with salinization, erosion, sand dunes, and temporary ponds, all of which retard crop development. Soil-vegetation discrimination is very accurate with spring and summer data. The spring image is appropriate to map winter crops. The summer image, however, is unfavorable to separate maize and sunflower. Spectral separability and classification accuracy is better with LANDSAT TM owing to its middle-IR band, compared to SPOT XS. ESA

N88-28355 Indian Space Research Organization, Ahmedabad. Space Applications Center.
WATER RESOURCES AND AGRICULTURAL LAND USE INVESTIGATIONS IN NORTHEASTERN GUJARAT (INDIA)
BALDEV SAHAI, R. K. SOOD, V. K. DADHWAL, and M. CHAKRABORTY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 107-112 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Groundwater potential and agricultural land use mapping was carried out using SPOT and LANDSAT TM and MSS data. Usefulness of SPOT in identifying hydrogeomorphological units and crops grown in small fields (less than 0.4 ha) is shown. ESA

N88-28360 Utrecht State Univ. (Netherlands). Working Group Remote on Sensing and Image Processing.
CHANGES IN SPECIES COMPOSITION OF HEATHLAND, MONITORED BY MEANS OF REMOTE SENSING AND FIELD MAPPING: THE RESULTS OF THE HEISPOT PROJECT
D. J. HARMS, J. T. DESMIDT, U. UITERWIJK (Eurosense B.V., Breda, Netherlands), and E. H. VANDERWAAL *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 153-165 1988
Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT-XS and PAN, LANDSAT Thematic Mapper (TM), and 70mm aerial photographs were evaluated for monitoring of the grassing process in heathland vegetation. All datasets, including the field data were processed on the same processing device. Value added data sets were created by integration of the SPOT-PAN data with the other satellite data. The analysis of the classification maps shows that the 30m resolution of TM is too low for distinguishing accurately heather from grass. The integration of TM and SPOT-PAN data shows considerably better results than the TM data alone. For a more global impression of the grassing situation all datasets can be used. Differences in vitality of heather are very hard to detect probably due to the lack of large patches of vital heather. ESA

N88-28362 Gadjah Mada Univ., Yogyakarta (Indonesia).
SPATIAL AND SPECTRAL REGISTRATION OF JAVANESE LANDSCAPE UNITS WITH SPOT
J. P. GASTELLU-ETCHEGORRY, D. ISAACSON, D. DUCROS-GAMBART, P. HILLEGERS, and M. OBBINK (Wageningen Agricultural Univ., Netherlands) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 175-180 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The utility of SPOT in monitoring the small scale, dynamic agro-forest ecosystems of Java was tested. The aim was to develop simple and accurate procedures which could be used with readily available supplies and equipment. The geometric registration consisted in defining a bilinear model for determining the relationship between the satellite and geo-referenced data. The use of these models eased the field checking and sampling of the local landscape units. The spectral characteristics of all units were determined. As a pre-classification test the results are encouraging in that typical land cover units are distinguished. Yet to be shown, however, is the degree to which tree cover, and to a lesser extent understory vegetation, influence spectral properties in a manner which is predictable and consistent. Post-classification studies are needed to establish the nature of overall spectral-cover associations. ESA

N88-28363 Nice Univ. (France). Dept. de Phytosociologie et Ecologie.
COMPARISON BETWEEN THE RESPECTIVE CONTRIBUTIONS OF THE TM LANDSAT-4 AND HRV SPOT-1 DATA TO THE LAND USE MAPPING OF MEDITERRANEAN COASTAL ZONE
ROGER MANIERE, JEROME COURBOULES, and CHRISTEL CHAMIGNON *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 181-189 1988 In FRENCH; ENGLISH summary
Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT HRV and LANDSAT-5 Thematic Mapper were evaluated by digital processing (unsupervised classification and supervised classification) for selected forest and subforest types in the south of France. Comparison of the numerical analysis of these data illustrates the improvements in resolution with SPOT. Based on analysis of the accuracy of supervised classifications, the optimum combination of TM and HRV data for discriminating forest and subforest cover types is either HRV2 or HRV3, and TM5 bands where the best spatial and spectral properties are obtained. ESA

N88-28369 Joint Research Centre of the European Communities, Ispra (Italy).
APPLICATION OF SPOT TO AGRICULTURAL INFORMATION SYSTEMS IN TEMPERATE REGIONS [APPLICATION DE SPOT AUX SYSTEMES D'INFORMATION AGRICOLE EN MILIEU TEMPERE]
JEAN MEYER-ROUX *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 231-238 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of remote sensing data in agriculture as a stratification tool to build an area sampling frame, to compute directly acreages by a classification of satellite data, and to forecast the yield component is discussed. Regression analysis; local statistics and thematic mapping; and a project to apply remote sensing to European agriculture are reviewed. ESA

N88-28370 Agricultural Research Service, Beltsville, Md.
POTENTIAL USE OF SPOT SATELLITE DATA FOR THE NATIONAL RESOURCES INVENTORY
JOHN C. PRICE and FRANK R. SCHIEBE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 239-244 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT were compared with other sources for a test site in Oklahoma to assess their usefulness for the National Resources Inventory. The capability to manipulate SPOT digital data, including combining 10 and 20 m data according to the procedures developed with the simulation data is established. The SPOT 10 m data are competitive with high altitude photography, but the cost is too great for routine use of digital data in this mode. Use of SPOT data could improve the efficiency of staff visits in detecting changes in resource conditions. However this possibility has to be tested. The LANDSAT digital data are competitive in some respects, and the significance of the 10 m resolution of SPOT requires further studies. ESA

N88-28371 Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
METHODOLOGICAL DEVELOPMENTS ON CROP INVENTORIES USING SPOT AND GROUND SURVEYS
G. SAINT *In its* SPOT 1 Image Utilization, Assessment, Results p 245-250 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Image processing techniques for crop identification using SPOT simulated images were studied. The capability to merge ground surveys and remote sensing was analyzed using SPOT real images from the last two Springs in different regions of France. Using classical sampling techniques and particularly regression analysis between remote sensing measurements and ground surveys areas inferred from a sample covering 1 percent of the total area, the variation coefficient is decreased by a factor of 3 to 6 when SPOT images are used, the accuracy being between 1 and 2 percent for the most important crops. ESA

N88-28373 Comision Nacional de Investigacion del Espacio, Madrid.
EVALUATION OF AUTOMATIC TEXTURE ANALYSIS FOR INCREASED CROP IDENTIFICATION ACCURACY WITH SPOT DATA
S. FERNANDEZ, F. REDONDO, A. SEDENO, M. ANTES, and N. ALSINA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 261-266 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Experiments were conducted in order to define the results that can be expected when classifying multispectral data over an agricultural area using the improved resolution of the SPOT instrument through numerical texture computation. Despite an apparent lack of texture information when panchromatic images from agricultural fields are examined visually, the used texture parameters indicate that a differentiation capability exists. A texture present at the pixel level (considering neighbors 1 pixel apart) and where gray level difference is not large is not easily visible but still detectable numerically by the used parameters. The case of textures from the panchromatic scene combined with multispectral channels from a different data presents an extreme accuracy of classification, due to the introduction of different dates in the analysis. ESA

N88-28374 Institut National de la Recherche Agronomique, Thiverval-Grignon (France). Station de Bioclimatologie.
APPLICATION OF SPOT MULTIDATE DATA TO WHEAT YIELD ESTIMATION IN BEAUCE (FRANCE)
P. BOISSARD, J.-G. POINTEL, and J. P. MOREAU (Institut National de la Recherche Agronomique, Versailles, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 267-277 1988 In FRENCH; ENGLISH summary Sponsored by CNES, France; CNRS, France; and Inst. National de la Recherche Agronomique, France
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Agronomical and yield data were collected directly from farmers for 100 hard and soft wheat fields. Statistical analysis of final yield considered as a function of SPOT-XS datas acquired at 3 dates is shown: r sq = 0.70 for hard wheat and 0.45 for soft wheat. It is shown that SPOT has acquisition flexibility and spatial resolution characteristics suited to crop survey. ESA

N88-28375 National Remote Sensing Centre, Farnborough (England).
AN EVALUATION OF MULTIDATE SPOT DATA FOR AGRICULTURE AND LAND USE MAPPING IN THE UNITED KINGDOM
N. JEWELL *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 279-293 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Four SPOT HRV images of the same area acquired between February and September were evaluated for their use in agricultural land cover mapping. Information from single images contain a high level of spectral confusion between cover types. Vegetation index images and original data were used in supervised maximum likelihood classification. Higher classification accuracies are achieved using the original data than the vegetation indices. An overall classification accuracy of 71 percent for 10 land cover types is improved to 88 percent by reducing the number of classes. Although the imagery acquired for the study did not correspond well to key dates in the crop calendar, the broad land cover categories, cereal crops, field crops (sugar beet and vegetables), grassland, and broadleaved woodlands could be mapped from SPOT. Using vegetation indices from the whole scene, a map of land cover was produced for an administrative district within the scene. Comparison with simulated TM data indicates greater crop discrimination is provided in the mid IR part of the spectrum. ESA

N88-28378 Canada Centre for Remote Sensing, Ottawa (Ontario).
HRV DATA FOR THE APPLICATIONS ON RENEWEABLE RESOURCES IN CANADA
J. CIHLAR, M. BERNIER, F. J. AHERN, O. DUPONT, and J. SIROIS (INTERA Environmental Consultants Ltd., Ottawa, Ontario) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 311-319 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The potential use of SPOT HRV data for three land resource applications was evaluated: land cover classification in a region with small fields, measurement of sizes of individual fields, and the mapping of forests infested by pine beetle. Various data types (MLA, PLA; nadir; oblique; TM) were analyzed. Visual and digital analysis techniques were employed. The results show the usefulness of higher spatial resolution for some applications and the importance of shortwave infrared bands for spectral classification of certain land cover types. ESA

N88-28379 Sheffield Univ. (England). Dept. of Geography.
SPOT-1 HRV DATA AND VEGETATION AMOUNT
P. J. CURRAN, F. M. DANSON, and R. N. LEAFE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 321-326 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Six land cover types were classified using SPOT HRV data to an accuracy of 79.5 percent to 91.5 percent (95 percent confidence level). For each land cover class a measure of vegetation amount (or its surrogate) was correlated with red radiance Lr and near-infrared radiance Lnir. Lack of information on when HRV data were recorded mean that data on vegetation amount were not collected synchronously with Lr and Lnir. Despite this vegetation amount is significantly correlated with Lr for urban land cover and with Lnir for urban and woodland land cover. The primary factors determining the reflectance properties of the woodland land cover are tree density and canopy shadow, the latter being related to plantation age. For the urban land cover the correlation between building density (inversely related to vegetation amount) and remotely sensed radiance is large enough to enable the estimation of building density with an error comparable to that obtained by a conventional ground survey. ESA

N88-28380 Centre National d'Etudes Spatiales, Toulouse (France).
ATTEMPT TO INVENTORY VINES USING OBLIQUE SPOT IMAGES [ESSAI D'INVENTAIRE DE LA VIGNE PAR IMAGES SPOT OBLIQUES]
JEAN DELEZIR and MAX GUY (Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse, France) *In its* SPOT 1 Image Utilization, Assessment, Results p 327-332 1988 In FRENCH Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Vertical and oblique SPOT images of vines were used to see if bushy vegetation can be detected using this method. Results show that vines can be detected by the difference between vertical and oblique saturation. Water, bare soil, vegetation, and crops in fields have marked global differences in pseudo panchromatic and chromatic images. There are, however, considerable practical problems: strict geometric rectification is required and, after principal components analysis to separate oblique-vertical differences, an intensity, hue, saturation transformation is needed. ESA

N88-28381 Institut National de la Recherche Agronomique, Paris (France).
ANALYSIS OF SOILS USING REMOTE SENSING INFORMATION AT THE SCALE OF THE PARCEL
D. COURAULT and M.-C. GIRARD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 333-340 1988 In FRENCH;

ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Remote sensing characterization of state of surface roughness of two fields corresponding to different soils: calcareous and sandy is described. Relationships between physical and chemical analysis of soils (performed in the field and in the laboratory) and spectral characteristics measured with spectrophotometer, field radiometer, and satellite data (SPOT and TM) are shown. Analysis of state of surface roughness types enables calcareous areas to be distinguished from loamy areas (with splash effect) presenting the same high radiance. ESA

N88-28382 Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris (France).
COMPARATIVE VARIATIONS OF SPECTRAL SIGNATURES IN A CULTIVATED AREA OF THE PARIS BASIN (27 MAY, 26 JUNE, 1 JULY 1986)
REGINE CHAUME, A. AING, I. RANNOU, D. CHAUME (Centre Univ. Sud de Calcul, Montpellier, France), A. COMBEAU, and D. MARTIN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 341-350 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The agriculture of an area based on the succession of winter wheat, beet, or wheat-maize was studied at the three dates characterizing the main stages of crop growth, using SPOT data. The distance between the first two is a month, between the last two is five days. The study of these crops is interesting for the difference of growth at the three obtained dates: wheat is maturing, beet and maize just covering the area. An opposite variation of the phenological states is observed. ESA

N88-28383 Joint Research Centre of the European Communities, Ispra (Italy).
MONITORING OF AGRICULTURAL PRODUCTION IN WEST AFRICA. THE NEED TO INTEGRATE DIFFERENT SATELLITE PLATFORMS [SURVEILLANCE DE LA PRODUCTION AGRICOLE EN AFRIQUE DE L'OUEST. NECESSITE D'UNE INTEGRATION DE DIFFERENTES PLATES-FORMES SATELLITAIRES]
J. P. MALINGREAU, E. BARTHOLOME, and E. BARISANO (Societe d'Etudes Techniques et d'Enterprises Generales, Sophia-Antipolis, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 353-370 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Remote sensing for crop production monitoring and forecasting is discussed. The complexity and the specific dynamics of the agricultural landscapes of the Sahelian and Sudanian regions (400 to 200 mm rainfall) make it necessary to use different remote sensing tools in combination. In a procedure involving agricultural landscape stratification and planted surface sampling, SPOT and TM imagery can give a useful support. For the monitoring of the natural vegetation-crop complex, the AVHRR approach is necessary. It is shown how remote sensed data improves the monitoring of rainfed crops in western Africa. ESA

N88-28385 Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DIGITAL AND VISUAL ANALYSIS OF SPOT AND TM DATA FOR CROP DISCRIMINATION IN SOUTHERN BRAZIL
GETULIO T. BATISTA, JEAN F. DALLEMAND, SHERRY C. CHEN, and ANTONIO T. TARDIN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 381-390 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Thematic Mapper (TM) data from LANDSAT and SPOT images were evaluated for the discrimination of coffee, pasture, winter wheat, and sugarcane using visual and digital analyses. The off-nadir viewing capability of SPOT and a comparison with LANDSAT TM data are emphasized. At the 95 percent significance level, no difference is observed among image products considering the 4 crops jointly. However, there is a significant difference between the four image products analyzed considering each crop category separately, and the best product varies for the different crop categories. No off-nadir viewing effect comparing 5.3 and 12.8 deg, both eastward is observed. The results of the digital analysis, considering all crop types jointly, using SPOT or the equivalent bands of TM (bands 2, 3 and 4) are not statistically different (at 95 percent level). However, results obtained by replacing one of the visible bands of the TM by band 5 improve the classification results. In this case, the performance of TM is significantly better than both SPOT panchromatic and one of the SPOT multispectral mode acquisitions. Despite the topographic characteristics of the area with slopes varying from flat to 5 percent, the effect of incidence angle is not found significant by the digital analysis. ESA

N88-28387 Louvain Univ. (Belgium).
DISCRIMINATION METHODS OF TRADITIONAL FIELDS IN A HUMID TROPICAL REGION (SHABA, ZAIRE) USING DIGITAL CLASSIFICATION ON SPOT DATA
P. DEFOURNY, J. SOYER (Liege Univ., Belgium), and M. MASSART *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 399-406 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In order to extract as much information as possible regarding agricultural fields in humid tropical areas, three classification methods were compared: by applying a low pass filter; by incorporating a neo-channel formed by the vegetation index of the normalized difference; by a bipolarization technique. The latter method essentially consists in treating those classes which contain large commission errors by a classification of maximum likelihood. This is achieved with the aid of two training sets, the statistical parameters of which being chosen according to the amount of correction needed. The validity of each method was checked with the aid of low altitude airphotos. ESA

N88-28388 Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France).
EVALUATION OF SPOT DATA FOR CROP INVENTORY AND MONITORING IN SUDANIAN AFRICA. EXAMPLE OF BANE AREA (BURKINA FASO)
P. Y. REVILLION *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 407-414 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Based on ground truth data, acquired from the Bane area during the 1986 agricultural season, an evaluation of SPOT multispectral and multitemporal data was established. Due to the disturbance of crop calendars caused by rain delays, the SPOT data were therefore not applicable to crop discrimination. However, information to be used in future SPOT programming was obtained, particularly as to the suitability of SPOT's image resolution. ESA

N88-28389 INERA (France).
IDENTIFICATION OF FARMING SYSTEMS IN THE COTTON AREA OF WEST BURKINA FASO FROM SPOT-1 DATA
C. BELEM, M. BERGER, J. KILIAN, G. LAINE, and P. MORANT (Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, Maisons-Alfort, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 415-419 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The interactive processing of 3 SPOT multispectral images (07.08.86, 11.15.86, 12.27.86) of Hounde area (Burkina Faso) on Pericolor 1000 system was done by a multidisciplinary team with one common field survey and numerous continuous field observations. Three maps were established at 1/34,000 scale: the first one to describe the agricultural parcels, the second to evaluate crop distribution (cotton and cereals), the third of natural

cover, important to identify fallow and appreciate the dynamic of crops extension in the studied area. The correct interpretation of the very rich information of the SPOT image was realized only through strict and accurate field observations. ESA

N88-28390 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
MONITORING TUNISIA'S STEPPES WITH SPOT
M. VANHEIST, W. VANWIJNGAARDEN, and H. HUIZING *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 421-428 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The use of SPOT for mapping landform and landcover; determination of standing crop; and monitoring cereal acreage and production in an arid area susceptible to overexploitation was assessed. Stereo SPOT images are very suitable for mapping landform. An advantage over LANDSAT and aerial photographs is that orientation in the field is fairly accurate. Identification/automatic classification of different cover and soil types is difficult/not possible. Variation in soil reflectance can be explained for a very large part by the value of the soil surface color biomass of cereals and weeds in cereal fields in the range of 700 to 8750 kg/ha fresh weight. Monitoring of cereal acreage is not possible on the basis of reflectance characteristics alone. Monitoring of cereal yield seems possible, but needs further work. ESA

N88-28391 Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
STUDY OF SAVANNAH FORMATION IN THE SUDANIAN ZONE. NORTHWEST SECTOR OF THE LA COMOE PARK, IVORY COAST [ETUDE DES FORMATIONS DE SAVANES DANS LA ZONE SOUDANIENNE. LE SECTEUR NORD OUEST DU PARC DE LA COMOE, COTE D'IVOIRE]
F. LAVENU, F. BLASCO, A. PODAIRE, PY. DESCHAMPS, J. C. ANOH, and A. AMAN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 429-443 1988 In FRENCH; ENGLISH summary Prepared in cooperation with Groupement Scientifique de Teledetection Spatiale de Toulouse, France, and Inst. de la Carte Internationale de laVegetation, France Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The SPOT 1 capability to discriminate, to classify, and to map the different tropical plant formations, where trees and shrubs are scattered is investigated. It is the first step for the calculation of wood resources in this region. Multispectral and multitemporal SPOT data were used. The results show that it is possible to discriminate and to map the different types of savannah at a large scale (1/35,000). ESA

N88-28392 Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi (Kenya).
PILOT STUDY OF RICE CULTURE IN SUB-TROPICAL HIGH POPULATION DENSITY REGION (MADAGASCAR) WITH SPOT 1 MULTISPECTRAL DATA
S. N. KALYANGO and E. MULLER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 445-454 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Two sets of SPOT multispectral data, collected on two separate dates over a rice scheme were interpreted for separation of rice land and discrimination of different rice phenological stages. The results of manual and digital analysis of the selected images indicate vast potential for multidate SPOT data. Three classification maps of rice and peripheral vegetation were generated from FCC prints and computer processed imagery data. More work is necessary to develop practical methods for estimating the actual seasonal rice acreage under different growth phases in order to achieve reliable results on production forecast. ESA

N88-28393 National Central Univ., Chung-Li (Taiwan). Center for Space and Remote Sensing Research.
USING SPOT HRV DATA TO UPDATE THE DISTRIBUTION OF THE PADDY FIELD IN TAIWAN
A. J. CHEN and K. S. KAN (Telecommunication Lab. DGT, Chung-Li, Taiwan) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 455-462 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It is demonstrated that SPOT data is capable of identifying the paddy field with sufficient accuracy if the major crop is rice. Multitemporal data is required if rice is mixed with other major crops. The proposed procedures are straightforward and can be easily implemented. ESA

N88-28394 Centre National de la Recherche Scientifique, Toulouse (France).
AGRO-ECOLOGICAL MAPPING FROM SPOT 1 DATA IN SOUTHERN THAILAND: NEW QUESTIONS FOR AN ANALYSIS OF THE FARMING-SYSTEMS
M. BRUNEAU, B. GALTIER, J. KILIAN, W. MUSIGASARN (Toulouse Univ., France), and P. J. ROCA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 463-470 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The interactive processing of one SPOT multispectral image of the Songkhla lake (Southern Thailand) on TRIAS system was done by a multidisciplinary Thai-French team with two field surveys (before and after processing). A surface-states map of each area (Phatthalung and Sathing Phra) was established at 1:50,000 scale. Fifteen classes are related to different surface-states resulting from the interaction of topography, materials, water, and land use. Especially different classes of paddy-fields reflect different levels of surface humidity on the hydromorphic soils. A humidity map and an agro-ecological map were derived at the 1:100,000 scale. To interpret the very rich thematic information of the image it is necessary to use other criteria than the spectral signatures, like proximity and stratification in types of environment. ESA

N88-28395 National Federation of Coffee Growers of Colombia.
SPOT APPLICATIONS ON COLUMBIA'S COFFEE ZONE
MANUEL V. GUERRERO *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 471-480 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Quantification of coffee crops using SPOT was assessed. Mono and stereoscopic visual interpretation research at different scales and on different bands was initiated, since it is important to research the 10 and 20 meters resolution, as well as the stereoscopy for land use and coffee coverage interpretation due to the high relief of crop areas. Results show that it is possible to identify at a general level the coffee plantations, other crops, cultural aspects, drainage, and that the production of thematic maps on soils, geology, physiography, is possible. Digital interpretation research using the magnetic tape of the scene assisted by ground truth survey and displaying the digital processing in the Pericolor 1000 system was tested. Analysis of spectral content is carried out through supervised sampling of land use types in field and data improvement treatments, such as vegetation index, band expansion dynamic, band separation, brightness index, and principal component analysis. Results show that it is possible to classify and quantify coffee grown areas as well as other land uses. ESA

N88-28405 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
MONITORING MONERAGALA (SRI LANKA) WITH SPOT IMAGERY
D. VANDERZEE *In* CNES, SPOT 1 Image Utilization, Assessment,

Results p 567-573 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Usefulness of SPOT images in a forest area rapidly being converted to agriculture to help planning is discussed. It is argued that panchromatic images monoscopically interpreted cannot be used for comprehensive benchmark mapping, no matter what type of enlargement is used, and monitoring of irrigated agriculture and forest and shrubland is only possible when using masks derived from such a comprehensive benchmark map. The multispectral image of the dry season gives much more information than the panchromatic one, but still not enough to arrive at a comprehensive benchmark map. Stereoviewing improves interpretation for benchmark mapping considerably but still does not make it comprehensive. For areas with no reliable and detailed topographical maps interpretation of a stereopair of images may be very worthwhile. Any project relying too much on stereo or on images of a very narrowly defined season is likely to fail, because getting images of very specific seasons may remain the strongest bottleneck for all types of applications. For monitoring of forest and shrub cover single multispectral images of the dry season suffice and can be used rather effectively. ESA

N88-28407 Reading Univ. (England). NERC Unit for Thematic Information Systems.
PRELIMINARY ANALYSES OF SPOT HRV MULTISPECTRAL PRODUCTS FOR ARID AND TEMPERATE ENVIRONMENTS
N. A. QUARMBY and J. R. G. TOWNSHEND *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 583-611 1988 (Contract NERC-F60/G6/12)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Two HRV multispectral scenes centered on the Chott el Djerid in Tunisia and London in England were used to test SPOT imagery. For the Chott el Djerid scene, all three HRV bands are very strongly correlated, and statistically the scene has an overall one dimensional structure, although the near infrared band provides unique information on the variability within vegetated areas. Each of the three bands has discriminatory potential, although HRV band 2 is the most useful single band, due to the lack of vegetation cover in this environment. In the London scene, the widespread presence of vegetation gives the scene a two dimensional structure similar to that which is found for LANDSAT Multispectral Scanner data in vegetated areas. The HRV bands 1 and 2 are highly correlated, but the near infrared band is negatively and poorly correlated with the visible bands. The single most useful band for cover type discrimination in this environment is HRV band 3. ESA

N88-28408 SEAMEO Regional Center for Tropical Biology, Bogor (Indonesia).
ASSESSMENT OF SPOT SATELLITE BASED SYSTEM IN HUMID TROPICAL VEGETATION IDENTIFICATION, CLASSIFICATION AND MONITORING
Y. LAUMONIER, U. R. DJAILANY, J. P. GASTELLU-ETCHE-GORRY, and R. BARKEY (Institut de la Carte Internationale de la Vegetation, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 613-621 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Following a vegetation mapping in Sumatra island (Indonesia), an assessment of SPOT satellite capability to handle specific problems related to vegetation identification and monitoring from remote sensing data was undertaken. Results of visual interpretation and multispectral analysis show the usefulness of SPOT data for the appraisal of tropical vegetation at medium scale, particularly for the swampy vegetation types including mangroves and for the secondary vegetation, for which considerable improvements are brought by multispectral classifications. The 20 m ground resolution is still not sufficient to provide information on primary forest patterns, nor to identify properly logged-over areas. Nevertheless, several degrees of depletion of the forest and all the serial stages are identified. The SPOT is a very good alternative to medium scale aerial photographs for the production of medium scale (1:100,000 to 1:250,000) vegetation and land use maps. ESA

N88-28409 Stockholm Univ. (Sweden). Remote Sensing Lab.
A COMPARISON BETWEEN SPOT AND LANDSAT TM FOR MAPPING OF VEGETATION AND BEDROCK OUTCROPS
L. WASTENSON, L. BORESJO, B. LUNDEN, and K. WESTER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 623-630 1988 Sponsored by the Swedish Board for Space Activities; the Swedish Environmental Protection Board; and the Swedish Natural Science Research Council Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The possibilities of mapping vegetation and bedrock outcrops using SPOT and LANDSAT-TM data are evaluated by comparisons with a detailed ground truth acquired by visual interpretation of IR color air photographs and field checks in Sweden. It is concluded that LANDSAT TM as well as SPOT HRV provide good possibilities for outcrop area mapping in this part of Sweden. There is no significant difference between the classification results for the two sensors, which indicates that neither the better spatial resolution of SPOT HRV nor the larger number of wavebands for LANDSAT TM is of crucial importance for this type of application. The classification errors are reduced by the use of a slicing procedure on the training data, and by spatial filtering of the classification results. ESA

N88-28411 Universite Catholique de Louvain (Belgium). Lab. de Teledetection.
ANALYSIS OF SPOT MULTISPECTRAL DATA CONCERNING A BORDER ZONE BETWEEN TWO GEOGRAPHICAL REGIONS IN SOUTHERN BELGIUM
M. L. DEKEERSMAECKER, P. JACQUES, and J. WILMET *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 637-646 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The high ground resolution of SPOT was used to take into consideration three main problems of interpretation in a regional contact area of southern Belgium: (1) the automatic classification of the most common categories of land use and the specific differentiation of crops. It is shown that if the former reaches a high degree of confidence, the latter admits of inadequate ecological conditions in the concerned region. (2) The cartography of hedges; SPOT is proved to be sufficiently accurate: a classification by increasing density levels of enclosures is performed. (3) The landscape synthesis is able to obtain a larger range of the spatial organization patterns at the subregional level. ESA

N88-28413 Nice Univ. (France). Phytosociologie et Ecologie.
UTILIZATION OF SPOT-1 MULTISPECTRAL DATA FOR MAPPING LAND COVER AND PHYTOHYGIENE MONITORING IN THE CENTRAL ZONE OF THE MERCANTOUR NATIONAL PARK (FRANCE) [UTILISATION DES DONNEES MULTISPECTRALES SPOT 1 POUR LA CARTOGRAPHIE DE L'OCCUPATION DES SOLS ET LE SUIVI PHYTO-SANITAIRE DANS LA ZONE CENTRALE DU PARC NATIONAL DU MERCANTOUR]
C. CHAMIGNON, J. CLAUDIN (Parc National du Mercantour, Nice, France), and R. MANIERE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 653-660 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Geographic information system (GIS) and SPOT data were compared. Adaptation and usefulness of the two data sources, land use mapping using SPOT data (by supervised classification), and monitoring of phytosanitary phenomena are discussed. The GIS enables ground truth test sites to be selected for SPOT. It also shows the importance of spatial homogeneity and

heterogeneity. Leaf diseases can only be detected in areas with good radiometric homogeneity, and in large affected areas. Data from LANDSAT Thematic Mappers should be combined with SPOT, to get the benefits of their respective spectral and spatial resolution. ESA

N88-28438 Groupement Scientifique de Teledetection de Strasbourg (France).
SPOT IMAGES AND GEOCHEMICAL MAPPING OF LATERITIC COVERS IN SOUTHERN MALI
C. ROQUIN, J. C. PION, and T. DANDJINOU *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 871-879 1988 Prepared in cooperation with Centre de Sedimentologie et de Geochimie de la Surface, France Original contains color illustrations
(Contract CNRS-ATP-1085; CNES-1265)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A detail geochemical mapping of superficial formations in South Mali is compared with high resolution SPOT satellite images. The two main landscape features in SPOT images are expressed by thematic indices derived from multispectral data. They reflect the distribution of vegetation cover and the distinction between silty clay soils in the valleys and ferruginous duricrust exposed on plateaus. Detritic material accumulation at the periphery of duricrust plateaus is shown by a geochemical halo of zirconium and quartz at their periphery, and by a narrow strip of high reflectivity with sparse vegetation cover on SPOT images. Distribution of vegetation on duricrusts is related to their kaolinite content. These relationships, either direct or indirect, existing between radiometric response and geochemical composition of superficial formations appear very useful for geological and mineral exploration of lateritic covers. ESA

N88-28441 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
SPOT FOR SLOPE INSTABILITY SURVEY IN NEPAL
K. GRABMAIER, A. M. TULADHAR, and H. TH. VERSTAPPEN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 895-903 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The suitability of SPOT stereo data for relief analysis, morphometric studies, and topographic mapping as applied to slope instability and erosion problems in the Nepalese Himalayas was assessed. The 1:50,000 photogrammetric mapping compares favorably with the existing topographic map. This is also true of the DTM. A slope map with 7 categories of slope angle was made (1:50,000). Natural vegetation and agricultural land use are mapped successfully. Problems are encountered with mapping roads and settlements on the panchromatic 1A level stereo pair. A detailed slope instability survey produced 1:10,000 maps which serve as a reference for the extrapolation of mountain hazard data over the entire SPOT frame. ESA

N88-28443 Sveriges Lantbruksuniv., Umea. Remote Sensing Lab.
SATELLITE REMOTE SENSING FOR FOREST MANAGEMENT. A REVIEW ILLUSTRATED WITH RESEARCH RESULTS ON SPOT 1 DATA
S. JAAKKOLA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 917-924 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Satellite remote sensing contributions to forest inventory and management are discussed. The most promising areas are monitoring resource changes; replacing aerial orthophotography; delineation, identification, and updating of units; standwise inventory; and forest inventory using sampling survey. ESA

N88-28444 North Carolina State Univ., Raleigh. Dept. of Forestry.
AN EVALUATION OF THE UTILITY OF SPOT AND THEMATIC MAPPER DATA FOR PROVIDING FOREST INVENTORY INFORMATION
JOHN A. BROCKHAUS, SIAMAK KHORRAM, and HEATHER M. CHESHIRE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 925-932 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Digital SPOT and Thematic Mapper (TM) data were evaluated in terms of their relationship to detailed forest inventory variables such as basal area and age class. Several of the SPOT and TM wavebands are found to be significantly correlated to basal area and age class, however, the correlation coefficients are so low as to preclude their use in any model development. Classification of the SPOT and TM data into 10 cover types demonstrates the importance of the 2 infrared wavebands in the TM that are not covered by SPOT. When each of the visible and near infrared wavebands were used an overall classification accuracy of 84.0 percent is achieved while an accuracy of 73.0 percent is obtained when the 4 SPOT wavebands are used. ESA

N88-28445 Sveriges Lantbruksuniv., Umea. Remote Sensing Lab.
SPOT-1 SATELLITE IMAGERY FOR FOREST INVENTORY IN SWEDEN
S. JAAKKOLA, L. JOHANSSON, and O. HAGNER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 933-942 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Digital SPOT-1 satellite imagery was evaluated for forest inventory purposes. The original SPOT-data was preprocessed using destriping, integration of PA and XS-bands to 10m resolution in color, natural color transformation, filtering for texture extraction. A texture-based algorithm was tested for finding logging roads. The timber stand delineation method developed integrates image segmentation, classification of segments using maximum likelihood classifier, and interactive editing of the result. The results show that finding new logging roads can be automated, computer-aided delineation (and identification) of timber stands leads to acceptable forest management units; and manual stand delineation using digitally enhanced SPOT-data (color prints) coincide with an actual forest map in 71 percent of the cases. ESA

N88-28447 Australian National Univ., Canberra. Dept. of Forestry.
FOREST MANAGEMENT APPLICATIONS OF SPOT DATA IN AUSTRALIA
B. J. TURNER, D. M. MOORE, and A. K. SKIDMORE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 953-959 1988 Sponsored by the Australian National Univ. Fund Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The value of SPOT data as an aid to management of exotic pine plantations and native eucalypt forests in Australia was investigated. Because subtle changes in stand density are detectable and locatable, SPOT appears to have real possibilities for monitoring operations in pine plantations. The SPOT data, like LANDSAT MSS, is more useful for mapping structural than floristic types in the native eucalypt forests. ESA

N88-28448 Institut National de la Recherche Agronomique, Cestas (France). Lab. de Bioclimatologie-Teledetection.
SPOT MULTISPECTRAL DATA AND MARITIME PINE STANDS IN SOUTHWEST OF FRANCE
D. GUYON and J. RIOM *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 961-970 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The small variation of SPOT data radiometric levels (similar to LANDSAT TM) on maritime pine stand forests is shown to limit the exploitation of this system (that is to say stereoradiometry and textural information due to the 20m resolution) in image analysis and simulation experiments. Visible spectral information differences between vertical and oblique views are due only to the sawing lines orientation. In the near infrared, stereoradiometry, by radiometric variability analysis, could reveal thinnings, but in which conditions must be defined. ESA

N88-28449 Technical Research Centre of Finland, Espoo.
STAND-BASED FORESTRY INVENTORY FROM SPOT IMAGE
THOMAS HAME, ERKKI TOMPPO, and EIJA PARMES *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 971-977 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A stand-based forest inventory method where the preliminary inventory results for a forest management plan are obtained by numerical interpretation of satellite scanner imagery was developed. Continuous variables such as tree stem volume are estimated using regression analysis whereas category responses such as the site type are estimated by maximum likelihood classification. Ground truth data are the field plots of the national forest inventory. The models for forest variables are applied to segmented imagery. Summer imagery gives similar or slightly better estimates for continuous variables than winter imagery. Higher spectral resolution would increase the accuracy of the estimates. The method can be implemented on a workstation. ESA

N88-28450 Ministere de l'Energie et des Ressources (Quebec).
POTENTIAL OF SPOT IMAGERY AS A TOOL FOR FOREST MAPPING IN QUEBEC [POTENTIEL DE L'IMAGERIE SPOT COMME OUTIL DE CARTOGRAPHIE FORESTIERE AU QUEBEC]
CHANTAL SEUTHE, JEAN BEAUBIEN (Department of the Environment, Sainte-Foy, Quebec), and JEAN-PIERRE LETOURNEAU *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 979-989 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Two SPOT XS images of forests were enhanced by principal component transform following a methodology developed for LANDSAT TM, slightly modified due to the lack of MIR band. Results are comparable to TM with more spatial accuracy, but do not show spruce budworm damage. The increased spatial resolution of SPOT does not exclude confusions inherent to spectral analysis. ESA

N88-28451 Polish Academy of Sciences, Warsaw. Inst. of Geodesy and Cartography.
ASSESSMENT OF LARGE AREA FOREST DISTURBANCES CAUSED BY BIOTIC AND ABIOTIC FACTORS ON THE BASIS OF SPOT IMAGES
Z. BOCHENEK, A. CIOLKOSZ, M. IRACKA, and J. ZAWILA-NIEDZWIECKI *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 991-996 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Forest damage assessment using SPOT data was evaluated. Determination of various levels of damage intensity; identification of various forms of forest disturbances: defoliation, tree mortality, loose forest canopy, windfalls and windbreaks, open areas; and comparison of information derived from SPOT data with information obtained with aerial photographs are discussed. Ground resolution of SPOT images is the major asset of these data. The SPOT images are directly applicable for forest studies, since reflected radiation is registered in spectral ranges in which the reflectance of green plants shows maximum differentiation. Additional sensing in the spectral ranges similar to channels 5 and 7 of LANDSAT Thematic Mapper would greatly benefit forest application of SPOT. Experience of using Cosmos space photographs reveals that these high-resolution data enable more precise thematic mapping than SPOT data. The SPOT images can be applied in forestry at the planning stage and for day-to-day forest management. Even though SPOT images do not provide evidence for detecting earlier stages of forest degradation, they are very valuable for valorization and monitoring of forests under stress. ESA

N88-28452 Forest Service, Paris (France).
STUDY OF DEFORESTATION IN THE VOSGES (FRANCE) BY REMOTE SENSING [ETUDE PAR TELEDETECTION SPATIALE DU DEPERISSEMENT DES FORETS VOSGIENNES]
P. BAZIRE, D. GUYON, A. JOLLY, J. RIOM, C. LALLEMAND, and G. LEGENDRE (Institut Francais du Petrole, Rueil-Malmaison.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 997-1011 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from LANDSAT TM (1984, 1986) and SPOT (1986) were used to study forest decline. Results show that forest damage inventory can be estimated with multidate images. Forest damage is not growing, and it seems that the evaluation of the decay is limited by this remote sensing technique. Panchromatic data should be assessed. Satellite systems are most useful to update forest maps. These maps are necessary to determine sampling procedures with CIR aerial photography (scale: 1/5000) for evaluating forest health. ESA

N88-28453 Universite Catholique de Louvain (Belgium).
CONTRIBUTION TO THE MAPPING OF FORESTS IN AN INTENSIVELY DIVIDED AREA, WITH THE HELP OF SPOT IMAGE DATA
N. ABOUSSOUAN and V. FELTEN (Walpot S.A., Namur, Belgium) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1013-1021 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The potential of SPOT image data for the mapping of the forest stands according to the species and the age of the trees, and in particular, for spruce damage monitoring was assessed, based on the simultaneous use of SPOT data and aerial infrared photographs. The results show that the classification of the stands, regarding the species and the age of the trees, is good but not as accurate as that obtained with LANDSAT TM data, in spite of the better spatial resolution of SPOT. Spruce damage is difficult to assess. Only certain strongly impaired areas can be located. ESA

N88-28454 Department of Resources, Surveys and Remote Sensing, Nairobi (Kenya).
SPOT 1: IMAGE UTILIZATION, ASSESSMENT, RESULTS. A STUDY OF THE ELBURGON FOREST AREA (KENYA) SHOWING THE SPECTRAL RESPONSES OF DIFFERENT FOREST TREE SPECIES
J. L. AGATSIVA, J. P. DELSOL, P. MAUREL, and S. RASSE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1023-1032 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT and LANDSAT were used to study Kenyan forests. The LANDSAT imagery used for the first study of forest cover were used to synthesize, specialize, and update the information but not to produce new information. Visual examination of SPOT 1 data shows a wealth of information as well as precision in detail for a forestry species map showing also its infrastructure (service roads, fire barriers). It allows for a real monitoring of areas interfering with the limits of gazetted forests according to plots. It allows for the distinction of natural forest plots from artificial forest plots (re-afforestation). Numerical analysis shows the clear definition of pine plantations, mature plantations, young plantations and cleared areas. Exotic species are impossible to classify. ESA

N88-28456 Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France). Service Applications de la Teledetection.
SPOT: A TOOL TO AID PRESELECTION OF SITES FAVORABLE FOR AQUICULTURE. EVALUATION AND PERSPECTIVES OF THE PRELIMINARY EVALUATION PROGRAM FOR SPOT (PEPS) ALIAS CALEDONIE [SPOT: UN OUTIL D'AIDE A LA PRESELECTION DE SITES FAVORABLES A L'AQUACULTURE. BILAN ET PERSPECTIVES DU PROJET PEPS ALIAS CALEDONIE]
L. LOUBERSAC *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1041-1049 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In the project ALIAS Caledonie SPOT derived products adapted to the inventory and the preselection of zones favorable for aquiculture development were conceived and set up. The impact of such products as to civil engineering, gain in precision, quality of presentation, cost, and delivery time is estimated. Ways for project extrapolations are proposed. ESA

N88-28477 Department of Administrative Services, Canberra (Australia). Surveying and Land Information Group.
ASSESSMENT OF SPOT IMAGERY FOR TOPOGRAPHIC REVISION AND VEGETATION MAPPING
C. VEENSTRA and C. MCMASTER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1229-1234 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The potential use of SPOT satellite imagery for topograhic map revision and vegetation mapping in Australia was studied. Considerations included completeness and accuracy of map information and in the case of topographic mapping the costs compared with aerial photography. In the unsupervised classification SPOT results are noticeably better than LANDSAT. Results are comparable when the classification is supervised, with a similar number of classes mapped from each image, but this depends on the number of classes specified by the operator, and this was the same in each case. Further work on the SPOT image could produce more classes. The greater resolution of SPOT gives a more detailed result but at the expense of greater imagery purchase cost and processing effort. The SPOT imagery can be digitally processed to give a detailed vegetation analysis of a selected area. ESA

N88-28498 Centre National d'Etudes Spatiales, Toulouse (France).
USE OF SPOT IMAGERY IN A GEOGRAPHIC INFORMATION SYSTEM [UTILISATION DE L'IMAGERIE SPOT DANS UN SYSTEME D'INFORMATION GEOGRAPHIQUES (SIG)]
MICHEL RAYSSIGUIER *In its* SPOT 1 Image Utilization, Assessment, Results p 1429-1436 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A test application about the suitability of soil for a given land use is presented in order to justify the specific contribution of SPOT imagery such as topological, thematic, and structural information. Methodological issues when using a raster geographic information system are reviewed. ESA

N88-28512# Research Inst. of National Defence, Linkoeping (Sweden).
VARIATIONS IN SPECTRAL REFLECTANCE SIGNATURE IN HEALTHY STANDS OF PINE AND SPRUCE
CARL HUGO AGREN Oct. 1987 26 p
(FOA-C-30468-3.1; ISSN-0347-3708; ETN-88-92704) Avail: NTIS HC A03/MF A01; Research Institute of National Defence, Box 1165, S-581 11 Linkoping, Sweden, 50 Swedish crowns

Spectral reflectance signatures in two stands of pine and spruce over two meteorologically very different seasons are presented. Significant changes which appear to be caused by natural reasons and which should not be confused with changes caused by man-made environmetal influences are shown. Applications to military reconnaissance are mentioned. ESA

N88-28514*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
USE OF LANDSAT IMAGES OF VEGETATION COVER TO ESTIMATE EFFECTIVE HYDRAULIC PROPERTIES OF SOILS Final Technical Report
PETER S. EAGLESON and MICHAEL F. JASINSKI 1 Aug. 1988 47 p
(Contract NAG5-510)
(NASA-CR-183185; NAS 1.26:183185) Avail: NTIS HC A03/MF A01 CSCL 02C

This work focuses on the characterization of natural, spatially variable, semivegetated landscapes using a linear, stochastic, canopy-soil reflectance model. A first application of the model was the investigation of the effects of subpixel and regional variability of scenes on the shape and structure of red-infrared scattergrams. Additionally, the model was used to investigate the inverse problem, the estimation of subpixel vegetation cover, given only the scattergrams of simulated satellite scale multispectral scenes. The major aspects of that work, including recent field investigations, are summarized. Author

N88-28523# Oak Ridge National Lab., Tenn. Carbon Dioxide Information Analysis Center.
BIBLIOGRAPHY ON TROPICAL RAIN FORESTS AND THE GLOBAL CARBON CYCLE. VOLUME 1: AN INTRODUCTION TO THE LITERATURE
CHARLES A. S. HALL, SANDRA BROWN, FREDERICK M. OHARA, JR., PHILIP B. BOGDONOFF, DIANA BARSHAW, ELIZABETH KAUFMAN, and SHEILA UNDERHILL May 1988 169 p
(Contract DE-AC05-84OR-21400)
(DE88-010761; ORNL/CDIAC-24-VOL-1) Avail: NTIS HC A08/MF A01

This bibliography covers the world literature on tropical rain forests, tropical deforestation, land-use change in the tropics, tropical forest conversion, and swidden agriculture as related to the global carbon cycle. Historic papers and books are included, but comprehensive coverage was only sought for 1980 through 1987. This compendium of nearly 2000 entries forms the point of departure for a series of bibliographies on this topic. Other work in this series will be on the global carbon cycle and rain forests in specific geographic areas, whereas this volume includes references to literature about the global carbon cycle and rain forests anywhere in the world. The bibliography is ordered alphabetically by author and is indexed by subject and author. DOE

N88-29210*# Washington State Univ., Pullman. Dept. of Astronomy and Soils.
SPECTRAL CHARACTERISTICS AND THE EXTENT OF PALEOSOLS OF THE PALOUSE FORMATION Final Report
B. E. FRAZIER, ALAN BUSACCA, YAAN CHENG, DAVID WHERRY, JUDY HART, and STEVE GILL Aug. 1988 41 p
(Contract NAS5-28758)
(NASA-CR-180947; NAS 1.26:180947) Avail: NTIS HC A03/MF A01 CSCL 08M

The objective of this study is to test the hypothesis that TM data is adequate in band selection and width and in spatial resolution to distinguish soil organic matter, iron oxide, and lime-silica contents to map several severity classes of erosion in soils of the Palouse region. The methodology used is as follows: (1) To develop spectral relationships from TM data that define the spatial distribution of soil areas by levels of (1) organic matter in the surface soil, (2) iron oxide and clay in exposed paleosol B horizons, and (3) lime-silica accumulations in exposed paleosol B horizons; (2) To compare areas determined by the method outlined in 1 to patterns interpreted from color aerial photos, and to ground observations on bare-soil fields; and (3) To define, on the basis of results of 1 and 2 to the extent possible, where exposed

paleosols exist within fields that are not bare, but have a crop cover, and the distribution of desirable and undesirable soil properties in each field. Author

N88-30165# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TM/LANDSAT-5 DATA TO EVALUATE WHEAT AND BEAN PERCENT SOIL COVER AND LEAF AREA INDEX
JOSE CARLOS NEVESEPIPHANIO and ANTONIO ROBERTO FORMAGGIO Jun. 1988 11 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4609-PRE/1332) Avail: NTIS HC A03/MF A01

The correlations are described between two crop parameters (green leaf area index and percent soil cover) and eighteen TM/LANDSAT-5 parameters (six bands and twelve band ratios). The TM/LANDSAT-5 data used were the digital numbers extracted from CCT's and corrected for minimizing atmospheric effects. It was used for three overpasses during wheat and bean vegetative cycles. The percent soil cover was estimated using 35 mm photographs taken perpendicular to the ground. The results showed that the correlation between remote sensing data and crop parameters is dependent on the level of expression of the crop parameters (crop stages). When the crop vegetative parameters are at their maximum expression there are poor correlations with remote sensing data. So, the more significant values of correlations were obtained in the pre-flowering stage. The most useful TM bands were TM4 and TM3, but their usefulness varied in function of the date of overpass, the crop family, and the crop parameter. Ratios were useful in cases where the single bands showed poor correlations, but no single ratio could be identified with good correlations in all situations. Finally, it was concluded that the knowledge of general development condition of crops is necessary in the selection of the most appropriate remote sensing parameter for correlation to the crop parameters considered in this study. Author

N88-30169# Societe Nationale Industrielle Aerospatiale, Cannes (France).
IMAGING INSTRUMENT OF THE VEGETATION PAYLOAD (SPOT 4)
R. KRAWCZYK and G. CERUTTI-MAORI 25 Mar. 1988 8 p
(SNIAS-881-440-107; ETN-88-92876) Avail: NTIS HC A02/MF A01

A SPOT 4 payload for an operational world-scale survey of the evolution of vegetation (forecasting of agricultural yields and environmental studies), and observation of oceanic areas is described. Field of view is + or - 50.5 deg (2000 km on ground), with observation frequency of less than 2 days at equator. The system, equipped with its own telemetry channels and on-board computers, sends coded data according 2 types of observation : world wide observation recording, then time-tagged transmission, with a nadir resolution of 1.165 km x 1.165 km or 4.66 km x 4.66 km (agglomeration of 16 pixels); and regional observation real-time transmission, with a nadir resolution of 1.165 km. It has a pushbroom CCD focal plane array with an imager consisting of five lenses (one for each band). ESA

N88-30172# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REFLECTANCE PATTERN AND THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THREE BRAZILIAN OXISOLS
ANTONIO ROBERTO FORMAGGIO and JOSE CARLOS NEVESEPIPHANIO Jun. 1988 11 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4590-PRE/1320) Avail: NTIS HC A03/MF A01

Spectral data were obtained in three data collection levels: laboratory (400 to 1100 nm), field (400 to 1050 nm), and satellite (MSS and TM/LANDSAT) in two areas with different parent materials. The soil physical and chemical parameters were highly correlated with the spectral reflectance pattern of the three studied Oxisols. The results showed the importance of parent material and texture as influencing parameters of the soils spectral pattern. Also, for the soild originated from eruptive basic rocks, clear indications were found that the inferences of soil properties relaged with iron oxides are possible due to the strong absorption that occurs in the spectra of these soils. Author

N88-30174# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF THE SPECTRAL RESPONSE OF SOYBEANS
GETULIO TEIXEIRABATISTA and BERNARDO RUDORFF, F. T. Jun. 1988 11 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4592-PRE/1322) Avail: NTIS HC A03/MF A01

The spectral responses of two soybean varieties planted monthly (in a period of three months) and their relationship to percent ground cover, biomass, and yield were investigated. The bidirectional reflectance factor was measured throughout the growing period (five campaigns at approximately 20-day intervals) of six experimental plots of 5 x 10 m size (three plots of each variety planted at one month intervals) using a 17 band (visible and NIR) portable radiometer. In each campaign, six measurements per plot were taken in order to obtain a representative estimate of the plot reflectance factor. Plant height and development stage were estimated concomitant to the radiometric measurements; biomass estimates were samples three times per plot during specific development stages (flowering, grain filling, and maturation), and total plot production was measured at-harvest. The percent ground cover was estimated through photographs taken simultaneously with the radiometric measurements. Results indicated that differences in reflectance between the two varieties correspond to differences in their biomass. However, in the visible peak at 550 nm, there is a slight difference between the two varieties. Preliminary analysis of spectral trajectory plots and vegetation indices indicated that the reflectance measures are related to the studied agronomic variables. Author

N88-30178# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MICROWAVE REMOTE SENSING AT INPE (INSTITUTE FOR SPACE RESEARCH) BRAZIL: CONCEPTS AND FUTURE PROSPECTS OF SOIL MOISTURE STUDIES
HERMANN J. H. KUX and JOAO VIANEISOARES May 1988 6 p Presented at the International Geoscience and Remote Sensing Symposium, Edinburgh, Scotland, 12-16 Sep. 1988
(INPE-4569-PRE/1310) Avail: NTIS HC A02/MF A01

The experiences obtained by INPE at microwave remote sensing, applied specifically to soil moisture studies, presenting the main concepts and prospects for future research, are described. In the approach proposed, information derived from ground truth, airborne and orbital data, as well as meteorological data, are important inputs. Author

N88-30179# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
RELIEF EFFECT CORRECTION ON LANDSAT IMAGERY FOR FOREST APPLICATIONS USING DIGITAL TERRAIN MODELS
LUIZ ALBERTO VIEIRADIAS, ENI ALVIMDEOLIVEIRA, and FLAVIO JORGE PONZONI Jun. 1988 12 p Presented at the 16th Congress of International Society of Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988
(INPE-4611-PRE/1334) Avail: NTIS HC A03/MF A01

Many times forests are planted on mountainous terrain. In this case the remotely sensed radiation at the LANDSAT sensor is highly dependent on the terrain slope, rendering difficult an accurate classification of the multispectral data. With a slope map derived from a digital terrain model (DTM), and information about the position of the sun, and the satellite sensor, it is possible to correct the image for the relief effect, by means of an illumination model. This work studies quantitatively the effect of this correction on the image classification, for an Eucalyptus ssp. forest near Jambeiro, SP, Brazil. Author

N88-30180# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LANDSAT TM AND AGROMETEOROLOGICAL DATA FOR WHEAT YIELD ESTIMATION AT THE FARM LEVEL
BERNARDO F. T. RUDORFF and GETULIO TEIXEIRABATISTA Jun. 1988 12 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4591-PRE/1321) Avail: NTIS HC A03/MF A01

Wheat plays an important role in the Brazilian commodity production. Therefore, objective and reliable methods for yield estimation are needed specially at the farm level where several management actions have to be taken. The LANDSAT TM and agrometeorological data were integrated in order to obtain a model for wheat yield estimation at the farm level for a test site in the south of Sao Paulo State. The LANDSAT data for the crop years of 1986 (three acquisitions) and 1987 (two acquisitions), agronomic and meteorological data were related to yield estimates at the field level (approximately 200 fields). Results have shown that vegetative index derived from LANDSAT TM explained 60 and 40 percent of wheat yield variability for the crop years analyzed. The joint use of both vegetative index and agrometeorological data in a single model improved significantly the results as compared to either vegetation index or agrometeorological data separately. The proposed model is to be validated for future crop seasons nevertheless it provided objective and accurate results for wheat estimation on the two crop seasons analyzed. Author

N88-30187# European Space Agency, Paris (France).
INVESTIGATION OF THE LARGE-SCALE IMPACT OF AIR POLLUTION COMPONENTS ON FOREST ECOSYSTEMS IN BAVARIA
DIETER PAFFRATH (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) and WOLFGANG PETERS Jun. 1987 191 p Transl. into ENGLISH of Untersuchung Grossraeumiger Luftschadstoffbelastungen im Zusammenhang mit den Waldschaeden in Bayern, Oberpfaffenhofen, Fed. Republic of Germany (DFVLR) Original language document was announced as N88-10434
(ESA-TT-1087; DFVLR-FB-87-17; ETN-88-92909) Avail: NTIS HC A09/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 47.50 deutsche marks

Typical mean distributions of pollutant concentrations were obtained on the basis of large-scale distributions of concentrations of SO2, NOx, ozone, and of acid-forming paticles over Bavarian forest damage areas measured by aircraft and vehicle. The impact of polluted fog on the forests in the Fichtelgebirge was investigated. The results show that no direct damaging effects of the SO2 and NOx gases can be detected. However, serious forest damage exists in the areas having the highest mean ozone concentration levels. It is not possible to establish a clear correlation between polluted fog and forest damage. ESA

N88-30263# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOME RESULTS FROM THE AMAZON FOREST MICROMETEOROLOGICAL EXPERIMENT
Y. VISWANADHAM, V. P. SILVAFILHO, L. D. A. SA, A. O. MANZI, L. C. B. MOLION, R. G. B. ANDRE, and J. L. M. NOGUEIRA Aug. 1988 7 p Presented at the International Conference on Tropical Micrometeorology and Air-Pollution, New Delhi, India, Feb. 1988
(INPE-4631-PRE/1346) Avail: NTIS HC A02/MF A01

This extended abstract presents some information about the radiation and energy balance parameters, and the Deacon numbers as a function of the Richardson gradient number. Author

N88-30532# Joint Publications Research Service, Arlington, Va.
ESTIMATION OF SOIL TEMPERATURE PROFILE FROM REMOTE MICROWAVE AND IR MEASUREMENTS Abstract Only
YE. A. REUTOV and A. M. SHUTKO *In its* JPRS Report: Science and Technology. USSR: Space p 24 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1987 p 78-85
Avail: NTIS HC A04/MF A01

A study is made of a method for estimating the soil temperature profile based on remote microwave and IR radiometric measurements. This article presents a broader interpretation of earlier results and does not assume constant moisture content with depth. All heat transfer processes in the soil are reduced to conduction, convection, radiation, and moisture transfer. The method is suitable for estimation of soil temperature down to 100 cm depth with a maximum absolute error of not over 5.0 to 5.5 C and a mean square error of 3 C. Author

N88-30533# Joint Publications Research Service, Arlington, Va.
MONTE-CARLO ESTIMATION OF THE INFLUENCE OF PLANT ARCHITECTURE PARAMETERS ON SPECTRAL BRIGHTNESS Abstract Only
YU. K. ROSS and A. L. MARSHAK *In its* JPRS Report: Science and Technology. USSR: Space p 24-25 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1987 p 86-93
Avail: NTIS HC A04/MF A01

A previous work stated the problem of calculating the reflection of radiation from a soil-plant system, constructed and demonstrated an algorithm based on the Monte Carlo method and described a plant cover model. This article turns primary attention to the study of the influence of the plant canopy architecture on the index of reflection. Factors analyzed include canopy height, distance between leaves, leaf size, canopy structure, leaf shape, genetic spiral angle of rotation and stems. The architecture is found to influence the index of reflection primarily in the area of reverse shine in the direction opposite to the direction of the incident sunlight and in the area around the nadir. Increasing the diameter of a circular leaf or decreasing the height of the canopy increases the spectral brightness coefficient. Increasing ellipticity of leaf shape decreases brightness. Near the nadir, the index of reflection depends on the contrast of spectral brightness between leaves and soil and the genetic spiral rotation angle. Increasing the fraction of vertical stems causes an increase in asymmetry of spectral brightness relative to the nadir direction. Author

02

ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metroplitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

A88-46355
GEOGRAPHY OF MEXICO CITY FROM A MULTIBAND SPOT 1 IMAGE [GEOGRAPHIE DE MEXICO D'APREUNE IMAGE SPOT 1 MULTIBANDE]
CL. BATAILLON (Toulouse II, Universite, France) Photo Interpretation (ISSN 0031-8523), vol. 26, Mar.-Apr. 1987, p. 47-51, 53, 55 (4 ff.). In French, English, and Spanish.

SPOT 1 images are shown to provide an accurate, high-quality, updated, continuous image of the Mexico City area. Images obtained at a scale of 1:50,000 are able to distinguish zones of industrial complexes, luxury dwellings, large estates, middle-class dwellings, and poor dwellings. Also present in the images are features such as lakes, reservoirs, various types of farmland, parks, and gardens. The data indicate that regions of uncontrolled urbanization to the east of the city are characterized by lower-class dwellings, the total absence of paved roads, and a lack of public transportation.

A88-46361
SPECTRAL ANALYSIS OF SPOT DATA OF A TROPICAL URBAN ENVIRONMENT (LUBUMBASHI, SHABA, ZAIRE) [ANALYSE SPECTRALE DES DONNEES SPOT RELATIVES A UN ENVIRONMENT URBAIN TROPICAL /LUBUMBASHI, SHABA, ZAIRE/]
J. SOYER and J. WILMET (Louvain, Universite Catholique, Louvain-la-Neuve, Belgium) Photo Interpretation (ISSN 0031-8523), vol. 26, July-Aug. 1987, p. 45-49, 51. In French, English, and Spanish. Research supported by the Services de Programmation de la Politique Scientifique of Belgium.

A88-51829
A SPACE REMOTE-SENSING INITIATIVE IN KEEPING WITH THE ISY, 1992
JOHN L. MCLUCAS (International Space Year Association, Washington, DC) and PAUL M. MAUGHAN (Space Development Services, Fort Washington, MD) Space Policy (ISSN 0265-9646), vol. 4, Aug. 1988, p. 229-239. refs

Proposals for establishing an international environmental resources satellite consortium are presented. All countries share a need for data on the earth and its resources, and economies of scale could be achieved through an international system. The formation of Inmarsat could serve as a model for setting up Envirosat. The role of Envirosat could expand as international confidence in it grows. Author

A88-52426
INTERNATIONAL SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT, 20TH, NAIROBI, KENYA, DEC. 4-10, 1986, PROCEEDINGS. VOLUMES 1, 2, & 3
Symposium organized and sponsored by the Environmental Research Institute of Michigan; Sponsored by the U.S. Agency for International Development, NASA, NOAA, et al. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. Vol. 1, 527 p.; vol. 2, 486 p.; vol. 3, 575 p. In English and French. For individual items see A88-52427 to A88-52545.

Papers concerning remote sensing and the environment are presented, including topics such as information for decision making, global monitoring and research, information systems for resource management, environmental monitoring and desertification, and early warning of environmental causes of African famine. Other aspects covered are geology and mineral resources, hydrology and water resources, agriculture and food resources, forestry and rangeland resources, mapping and charting, ocean and coastal applications, and earth observation systems for resource and environmental assessment. The use of Landsat MSS and TM, SIR, SPOT, MOMS, Meteosat, and NOAA/AVHRR data, computer based geographic information systems, gold exploration, groundwater survey, flood monitoring, crop estimations, rangeland monitoring, wildlife tracking, coral reef studies, coastal change detection, international cooperation in remote sensing, monitoring sand movement, structural analysis, mapping sediments, image processing, rainfall assessment, watershed management, biomass energy mapping, impacts of dam construction, vegetation mapping, extraction of hydrological parameters, remote sensing of urban environments, space maps, topographic mapping, Fourier models for interpreting thermal-IR imagery, and the monitoring of landuse changes. R.B.

A88-52441#
QUICK RESPONSE MONITORING OF FLOOD DISASTERS FROM SATELLITE IMAGERY
MORRIS DEUTSCH, DONALD R. WIESNET (Satellite Hydrology, Inc., Vienna, VA), STEPHEN O. BENDER (Organization of American States, Washington, DC), and WILLIAM H. WILCOX (Partners of the Americas, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 255-258. refs

In 1984 the Landsat Emergency Access and Products (LEAP) Program of the National Oceanographic and Atmospheric Administration (NOAA) became operational to provide for prompt acquisition and processing of Landsat data over areas officially declared to be disasters - such as floods - by the U.S. Federal Emergency Management Agency. This paper summarizes case histories of quick response flood monitoring for use by state, national or international organizations in decision-making processes. The case histories not only include the use of Landsat data for quick response flood monitoring but also the use of NOAA and Nimbus satellite data. The purpose of this paper is to describe state-of-the-art acquisition, processing, enhancement and conversion of data to analog and image-map format. It also recommends establishment of disaster-monitoring capability at all appropriate earth-observation satellite receiving stations worldwide. Author

A88-52457#
DEVELOPMENTS IN GLOBAL DATA BASES FOR THE ENVIRONMENTAL SCIENCES - DISCUSSION AND REVIEW
JOHN J. KINEMAN, DAVID A. HASTINGS, and JEFF D. COLBY (NOAA, National Environmental Satellite Data and Information Service, Boulder, CO) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 471-482. refs

This paper analyzes the needs for expertise, data, and technology that are implied in the emerging trend toward systems science in earth studies. Global data bases are discussed in reference to their development and to the systems and applications that will require them. Plans for future products and services for the environmental sciences in the emerging 'global systems' era are outlined. It is not the purpose of this paper to focus solely on large international programs. However, the recently approved International Geosphere-Biosphere Program can be considered as a conceptual 'umbrella' regarding the issues and trends that are likely to face regional, national, and global environmental-ecological studies in the coming decade. Author

A88-52459#
THE USE OF REMOTE SENSING TECHNIQUES FOR LANDUSE ASSESSMENT AND PLANNING AT DISTRICT LEVEL IN KENYA - A CASE STUDY OF MERU DISTRICT
HUGH GIBBON and PAUL MATHER (Nottingham University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 489-498. Research supported by the Economic and Social Research Council. refs

A88-52461#
ENVIRONMENTAL CHANGES AROUND AFRICAN TROPICAL TOWNS (LUBUMBASHI, ZAIRE; BAMAKO, MALI) FROM LANDSAT MSS DATA
J. SOYER and J. WILMET (Louvain, Universite Catholique, Louvain-la-Neuve, Belgium) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 507-519. EEC-supported research. refs

Analog techniques (contrast enhancement, color-composites) as well as digital ones (mono- amd multispectral supervised methods, box classification, maximum likelihood classification, NDVI and PVI) were used to study environmental changes around tropical towns. A comparison was made between Bamako, Mali and Lubumbashi, Zaire, both towns located at nearly the same latitude (12 deg), North and South, and with nearly the same amount of population (600,000). The most efficient method was the maximum likelihood classification based on carefully selected training areas. The forests and woodland with a foliage cover greater than 40 percent, are easily detected and mapped. Other wood-fuel reserves associated with tree or park savannas are difficult to evaluate. Author

A88-52466#
NEDRES - A MODEL FOR AN INTERACTIVE ENVIRONMENTAL DATA REFERRAL DATA BASE FOR AFRICA
GERALD S. BARTON (NOAA, National Environmental Satellite Data and Information Service, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 583-590. refs

The National Environmental Data Referral Service (NEDRES) is a model of a computer data referral system which could be used as a directory to environmental data in Africa. The data base could be used as it exists, or it could be easily modified to suit the needs of users in Africa. Information of data would then be available from a single source for researchers, scientists, data users, and managers. The NEDRES data base indentifies the existence, location, characteristics and availability of environmental data. It is a publicly available service which allows easy access to data information that could be useful for problem solving. NEDRES describes the data and directs the user to the holder of the data, but the data are not available from NEDRES. Author

A88-52467#
THE ROLE OF REMOTE SENSING IN EUROPEAN/AFRICAN COOPERATION FOR DEVELOPMENT
R. KLERSY and H. MARTIN (CEC, Brussels, Belgium) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 609-614.

Remote sensing from space which has proven to be a powerful tool for many sectors of application can contribute to and even accelerate the economic and social development of developing countries; more specifically in Africa such technology has a good prospect for drought early warning and monitoring as well as for crop forecasting. Despite this, many constraints still remain to be answered wich limit the number of actions engaged up to now in Africa. This is the reason why the Commission of the European Communities has supported and is ready to support actions promoting and using remote sensing from space. Author

A88-52470#
DEVELOPMENT AND APPLICATIONS OF A GEOGRAPHIC INFORMATION SYSTEM FOR NATURAL RESOURCE MANAGEMENT IN RWANDA
E. L. ADERHOLD (Agency for International Development, Kigali, Rwanda) and A. W. WEBER (South-East Consortium for International Development, Chapel Hill, NC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 659-668. Research sponsored by the Agency for International Development. refs

A88-52475*# National Air and Space Museum, Washington, D.C.
REMOTE SENSING OBSERVATIONS OF SAND MOVEMENT IN THE BAHARIYA DEPRESSION, WESTERN EGYPT
TED A. MAXWELL and PATRICIA A. JACOBBERGER (National Air and Space Museum, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 721-729. Research supported by the Smithsonian Institution.
(Contract NAS5-28774)

Aerial photographs taken in the 1940's have been used in combination with recent Landsat MSS and TM data to study dune movement in the Western Desert of Egypt. The El-Ghorabi dunes track northwest to southeast along the eastern edge of the Bahariya Depression. These dunes are of complex longitudinal form with well-defined, lag-covered interdune corridors. Studies using both aerial coverage and multitemporal MSS and TM image data reveal little or no net southward extension or movement of the seifs, although field measurements and remote sensing data indicate small-scale lateral migration of dune crests and interdune corridors through time. The primary process of sand transport for these dunes seems to be in response to seasonal shifts in dominant wind direction, as reflected in the development and rapid response of sand shadows leeward of the main dune masses. Author

A88-52477#
SURFACE ALBEDO VARIATIONS DUE TO LAND USE CHANGES SINCE 1973 IN THE WESTERN PART OF THE DOMINICAN REPUBLIC
L. FOURNIER, A. ROYER, and F. BONN (Sherbrooke, Universite, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 743-754. Research supported by the Ministere de l'Education du Quebec and Canadian International Development Agency. refs
(Contract NSERC-A-8643)

The purpose of the project is to study the spatial and temporal variations of the physical parameters of the earth's surface due to changes in land use in relation with climatic modifications using satellite remote sensing. The aim of the study is set forth in the framework of the ISLSCP project (Bolle and Rasool, 1985). Results from Landsat MSS sensor data analysis of the Western part of the Dominican Republic (150 x 150 kms) in 1973, 1979, and 1985 are presented. Data are corrected radiometrically and calibrated using the radiance of pure water as a time standard reflector. The calibrated data obtained were combined for albedo. An important decrease of surface albedo (19 percent) was observed since 1973 in the study area. Comparison of the time series thematic cartography has permitted to relate this albedo variation with land use changes. Areas for the different land use types were calculated and compared for each year. Author

A88-52479#
APPLICATION OF HIGH-RESOLUTION REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS TO THE JORDANIAN COAST (GULF OF AQABA, RED SEA)
ROGER MANIERE, JEROME COURBOULES, JEAN JAUBERT (Nice, Universite, France), CLAUDE BOUCHON (UniversiteAntilles-Guyane, Pointe-a-Pitre, Guadeloupe), and DUREID MAHASNEH (Aqaba Region Authority, Jordan) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 771-780. refs

A88-52521#
STUDY OF THE IMPACT OF POPULATION PRESSURE ON LAND RESOURCES ON THE MAU ESCARPMENT (KENYA) USING SPOT SATELLITE DATA
S. KALYANGO, E. MULLER, and L. ISAVWA (Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1255-1271. refs

A88-52531#
USING OF LANDSAT TM DATA TO STUDY AND MANAGE THE URBAN ENVIRONMENT OF THE BIG CITIES - PARIS REGION
R. DELAVIGNE, C. THIBAULT (Ile-de-France, Institut d'Amenagement et d'Urbanisme, Paris, France), MICHEL LENCO (Ministere de l'Environnement, Delegation a la Qualite de la Vie, Neuilly-sur-Seine, France), and V. MARIETTE (SFERES-Teledetection, Montrouge, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1363-1370.

A88-52539#
MONITORING OF LANDUSE CHANGE AS A TOOL FOR DEVELOPMENT PLANNING - A DECADE OF FCC VISUAL DATA FOR THE NAIROBI AREA
M. H. WEEDA and F. GROOTENHUIS (Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1429-1438. refs

A88-52540#
LAND USE INVENTORY AND MONITORING IN EGYPT USING THEMATIC MAPPER DATA
N. A. PROUT and J. T. SUTTON (Intera Technologies, Ltd., Ottawa, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1439-1448. Research supported by the Canadian International Development Agency. refs

A88-53528
HIGH-RESOLUTION SURFACE TEMPERATURE PATTERNS IN A COMPLEX URBAN TERRAIN
ROBERT C. BALLING, JR. and SANDRA W. BRAZEL (Arizona State University, Tempe) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Sept. 1988, p. 1289-1293. Research supported by the Salt River Project. refs

In this investigation, the polar-orbiting AVHRR thermal scanner is used to produce one-kilometer resolution surface temperature patterns of Phoenix, Arizona. The resulting map shows realistic, high-resolution temperature variations across the metropolitan area. The derived surface temperatures covary with incidence of residential, commercial, and industrial land use and indirectly covary with the vacant land cover. The AVHRR system appears to provide the capability of significantly increasing the spatial resolution of thermal fields across an urban area. The results of the study are being used by a local utility in their analyses of water and power consumption. Author

A88-55143
INTERCOMPARISON OF TOTAL OZONE MEASURED BY THE BREWER AND DOBSON SPECTROPHOTOMETERS AT TORONTO
J. B. KERR, I. A. ASBRIDGE, and W. F. J. EVANS (Department of the Environment, Atmospheric Environment Service, Downsview, Canada) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Sept. 20, 1988, p. 11129-11140. refs

A88-55344#
INTEGRATED LAND MANAGEMENT WITH REMOTE SENSING
BHASKAR DAS (ISRO, Space Applications Centre, Ahmedabad, India) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 6 p.
(IAF PAPER 88-143)

Land management applications of the Indian Remote Sensing satellite, IRS-1A, are discussed. The IRS-1A was launched in March, 1988 and has three sensors: two with 36.25-m resolution, and one with 73.5-m resolution. The role of remote sensing in the Indian land management system is examined and the land quality parameters which can be determined from satellite imagery are outlined. The economic benefits of using remote sensing for land management are considered. R.B.

A88-55345#
SCENARIO FOR DEVELOPMENT OF GEOGRAPHIC INFORMATION SYSTEM FOR NATURAL RESOURCES MANAGEMENT WITH EMPHASIS ON REMOTE SENSING OUTPUTS
E. V. P. PARTHASARADHI, K. KRISHNANUNNI, BHANU MASTHAN, and R. K. DAS (Department of Space and Space Commission, Regional Remote Sensing Service Centre, Bangalore, India) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 8 p. refs
(IAF PAPER 88-144)

The development of a geographic information system which could be used as a data base for natural resources management in India is discussed. Plans are presented for creating a digital cartographic data base through video digitization and incorporation of remotely sensed and cartographic thematic information. The processes for manipulating, storing, retrieving and presenting data are examined. Two examples of using a geographic information system are presented: the use of AVHRR data to compute the normalized vegetation index and surface green biomass in India, and the preparation of thematic maps on 1:500,000 scale. R.B.

A88-55349#
LANDSCAPE INDICATION OF DESERTIFICATION USING SPACE IMAGES
E. V. GLUSHKO (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 9 p.
(IAF PAPER 88-163)

Space images have been used to study the desertification process in subboreal deserts in the Soviet Union, in subtropical deserts in Iraq, and in tropical deserts and savannas in India. Color spectrozonal and black-and-white photos taken from the orbital station Salyut in 1975, 1978, and 1980 on the scale 1:2,400,000 with a resolution of 70 m, and images from the Meteor-30 satellite were used to study the Kyzylkum desert in the Soviet Union. The deserts in India were studied with Landsat MSS imagery from 1972 on the scale 1:336,000 and Salyut imagery from 1984 on the scale 1:2,000,000. Diagrams of the landscape are presented and the way in which they were used to detect various desertification processes is discussed. R.B.

N88-25939# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
NATIONAL MEETING ON REMOTE SENSING APPLIED TO MUNICIPAL PLANNING [ENCONTRO NACIONAL DE SENSORIAMENTO REMOTO APLICADO AO PLANEJAMENTO MUNICIPAL]
1987 301 p In PORTUGESE Meeting held in Campos do Jordao, Brazil, 22-23 Oct. 1987 Prepared in cooperation with Sociedad de Especialistas Latinoamericanos en Percepcion Remota, Chile Sponsored by Prefeitura Municipal da Estancia de Campos do Jordao and Secretaria da Cultura do Estado de Sao Paulo
Avail: NTIS HC A14/MF A01

Topics addressed include: land use mapping; remote sensing applications; satellite imagery of agriculture activity; impact of occupation in urban areas; photointerpretation; production of hemp; municipal planning; computer graphics; and aerial photography.

N88-25940# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
MAPPING OF LAND USE IN SAO JOSE DOS CAMPOS MUNICIPALITY BY REMOTE SENSING, AN AID FOR THE ELABORATION OF ITS PDDI [MAPEAMENTO DO USO DA TERRA DO MUNICIPIO DE SAO JOSE DOS CAMPOS POR SENSORIAMENTO REMOTO, COMO SUBSIDIO PARA A ELABORACAO DO SEU PDDI]
MADALENA NIEROPEREIRA, MARIA DELOURDESNEVES-DEOLIVEIRAKURKDJIAN, and BERNARDO DEOLIVEIRASAM-PAIO *In its* National Meeting on Remote Sensing Applied to Municipal Planning p 1-19 1987 In PORTUGUESE Avail: NTIS HC A14/MF A01

This work seeks to show the use of remote sensing data for the realization of land use inventories, with the view to the elaboration of the Administrative Plans for Integrated Municipal Development (PDDI). Based on results obtained from the project, Updating of land use in the Sao Jose dos Campos municipality through remote sensing data - AUTES, relevant information was identified as the diagnostic realization of municipal territorial

organization, obtained through orbital imagery, which is utilized as an aid for the elaboration of the PDDI. Author

N88-25941# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
REMOTE SENSING TECHNIQUES APPLIED TO THE STUDY OF METROPOLITAN REGIONS: THE WEST SECTOR OF THE SAO PAULO METROPOLITAN AREA [TECNICAS DE SENSORIAMENTO REMOTO APLICADAS AO ESTUDO DE REGIOES METROPOLITANAS: O SETOR OESTE DA AREA METROPOLITANA DE SAO PAULO]
CELINA FORESTI *In its* National Meeting on Remote Sensing Applied to Municipal Planning p 20-31 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

The remote sensors on board new satellites are more and more adequate for urban study, in increasing the functional capability of spatial, spectral, and radiometric resolution. This work presents a methodological focus for the study of expansion and structurization of urban space in metropolitan areas through orbital remote sensing data in different levels and scales of observation. Data from LANDSAT MSS and TM and digital panchromatic HRV data from the SPOT satellite are utilized. The experimental area corresponds to the western sector of the Sao Paulo metropolitan area, constituting an urbanized area or municipalities in the process of urbanization in Osasco, Carapicuiba, Barveri, Itapei, Jandira, and Santana do Parnaiba. The results of the work show urban expansion occurring with the opening of new land plots which are constantly deep-rooted, of adequate form, and adapted to ground conditions. Measurement is aggravated by this problem, which is most unevenly raised, presenting the major indices of declivity. This work discusses the current atmospheric problems in the use and disorganized ground occupancy, also the nonexistence of planning and integrated administration for composition of the metropolitan regions of Brazil. Author

N88-25942# Sensoriamento Remoto dos Recursos Naturais, Rio de Janeiro (Brazil).
TERRITORIAL MANAGEMENT PROGRAM
LUIZ HENRIQUE AZEVEDOELARAMUSSEFELIX *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 32-48 1987
Avail: NTIS HC A14/MF A01

The Territorial Management consists of a first element, a survey of information from the territory, adequate space planning in its vocation and natural potentiality assignment considered through physical-spatial diagnostics. The next stage, second element, represents the design implantation, where the interaction of the modules orient the process, Diagnostic Planning, was systematically reviewed. Author

N88-25944# Fundacao de Ciencia, Aplicacoes e Technologia Espaciais, Sao Jose dos Campos (Brazil).
THE USE OF SATELLITE IMAGERY FOR MUNICIPAL CONDITIONS IN RURAL RECORDING IN PEREIRA BARRETO (SP)
KLEBER DEFARIA, CASSIA B. S. VEIGA, MARCIA MORGADO, RENATO DOSSANTOS, MARCOS COVRE, RICARDO L. V. RODRIGUES, FRANCISCO JOSE MENDONCA (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil), and FLAVIO GEWANDSNAJDER *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 58-68 1987
Avail: NTIS HC A14/MF A01

To be considered for the requirement of area selection for rural registration for the short term, capable ways and means should be utilized to perform the whole process which involves an expropriation. The primary stage of this process is the selection of areas which present a low degree of utilization. This mapping by satellite imagery, was shown as an instrument useful for information collection of natural resources destined for agriculture. This work analyzes the soil use, basically through the vegetal cover existing in the Pereira Barreto municipality, located north of the Sao Paulo State. The objective was to quantify areas with a low degree of utilization of municipal conditions of ownership. The TM/LANDSAT imagery is utilized in black and white documents, channels 3 to 4, scale 1:100,000 with data from the 12 November 1985 to 24 June 1986 passage. Through visual analysis the imagery was separated into three classes: clean fields; dirty field of bushveld; and woodsy/pasture. The dirty fields of bushveld are considered as areas of potential expropriation. Therefore, the results encountered concerning this subject are 28 percent of the municipal territory and for the conditions of ownership that were studied: Fazenda Conquista, totally utilized; Fazenda Maria Ofelia, 42 percent; Fazenda Sao Joaquim, 48 percent; Fazenda Santa Terezinha, 56 percent; Fazenda Esmeralda, 67 percent; Fazenda Sao Rafael, 78 percent; and Fazenda Sao Lutz, 100 percent. Author

N88-25945# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
THE IMPACT OF DISORGANIZED OCCUPATION OF URBAN SUB-BASINS: SUB-BASIN OF THE CABUCU RIVER, METROPOLITAN AREA OF SAO PAULO (SP)
SERGIO LUIS POMPEIA and CELINA FORESTI (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 69-79 1987
Avail: NTIS HC A14/MF A01

Color composites of satellite multispectral remote sensing data were used in order to study the evolution of urban spread and consequent results in the basin of the Cabucu de Cima River of the metropolitan area of Sao Paulo. The results refer to MSS-LANDSAT data obtained in June 26, 1976, and by TM-LANDSAT data from June 16, 1985. These scenes were magnified by the Interative Multispectral Image Analyzer System (IMAGE-100) to the scale of 1:50,000. Three classes of color and texture patterns were established according to the ground occupation level. The final results were plotted at the scale of 1:25,000. Selected patterns and their geographic limits were field checked in order to allign the confection of maps of the basin ground occupation for 1976 and in 1986 scenes, indicating areas exposed to inundation hazards. Author

N88-25946# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PHOTOINTERPRETATION WITH INSTRUMENTATION FOR EVALUATION OF ENVIRONMENTAL IMPACT: MATA ATLANTICA IN CUBATAO [A FOTOINTERPRETACAO COMO INSTRUMENTO PARA AVALIACAO DE IMPACTO AMBIENTAL: A MATA ATLANTICA EM CUBATAO]
DALTON DEMORISSONVALERIANO and FLAVIO JORGE PONZONI *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 80-96 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

In order to study the impact of the atmospheric pollution originating from the Cubatao industrial plants over the Mata Atlantica (a strip of tropical rain forest formation that stretches along the Brazilian eastern coast) on the slopes of the Serra do Mar (a mountain chain that runs parallel to the southeastern coast), color infrared air photography (1:25,000) was used to map the vegetation cover and the land use of approximately 240 sq km, covering degraded areas (Mogi River valley) and preserved areas (Quilombo River valley). The photographic analysis found that the degradation of the vegetation structure by the air pollution is done by the selective and progressive elimination of the largest elements, which may, in its most intensive level, reduce the forest into a shrubbery. Considering that the Mata Atlantica slowly builds its capacity to preserve slope stability, a long period in which the risk of a natural disaster by means of landslides is foreseen as a great threat to the region in the rainy season. Author

N88-25949# Instituto Florestal, Sao Paulo (Brazil).
APPLICATION OF REMOTE SENSING IN THE CONSERVATION OF NATURAL AREAS: RIBEIRA VALLEY [APLICACAO DO SENSORIAMENTO REMOTO NA CONSERVACAO DE AREAS NATURAIS - VALE DO RIBEIRA]
HIDEYO AOKI *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 131-143 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

This is a description of studies carried out in the Parque Estadual de Jacupiranga, spreading over Barra do Turvo, Cananeia, Eldorado, Paulista, Iporanga, and Jacupiranga counties, utilizing LANDSAT imagery and aerial photographs. The studies permitted subsides on the biophysical environment characteristics and the establishment of guiding and/or the decisions to be made by the county and/or state governments, to assure the compliment of legal measures of protection and to avoid the irreversible degradation of one of the more fragile and important ecosystems of the Brazilian territory. Author

N88-25951# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING TECHNIQUE APPLIED TO VEGETATION AS AN AID TO MUNICIPAL PLANNING [O SENSORIAMENTO REMOTO APLICADO A VEGETACAO COMO SUBSIDIO AO PLANEJAMENTO MUNICIPAL]
DALTON DEMORISSONVALERIANO, JOAO ROBERTO DOSSANTOS, PEDRO HERNANDEZFILHO, and VITOR CELSODECARVALHO *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 151-164 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

The rational exploration of the natural resources of a municipality must be one of the objectives of its administration. New technologies offer means and alternatives that make possible the full utilization of the natural resources within the limits of the carrying capacity of the environment. Remote sensing of the vegetation is one of these available means. The assessment of the vegetation cover through mapping and inventories provides basic informations for the establishment of policies and strategies for the development. The monitoring of the vegetation, which is made through periodic updating of its assessment, allows the evaluation of the results of the policies, besides the fact that it depicts trends in the pattern of resources exploration. The applicability of the remote sensing of the vegetation to the municipal planning through the analysis of its foundations and methodological pecularities are discussed. Case studies of the Brazilian vegetation are presented in order to picture the state of the are of the subject in Brazil. Author

N88-25952# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UPDATING OF MUNICIPAL OFFICIAL REGISTER OF REAL ESTATE THROUGH THE GEOGRAPHICAL INFORMATION SYSTEM [ATUALIZACAO DO CADASTRO IMOBILIARIO MUNICIPAL ATRAVES DE UM SISTEMA DE INFORMACOES GEOGRAFICAS]
ADRIANA ABRAHAO and MOACIR GODOY, JR. *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 165-179 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

The objective is to demonstrate the viability of automatization of municipal official register of real estate using the geographical information system now in development at INPE. The test area was Jambeiro City located in the Vale do Paraiba region, Sao Paulo state. All the pilot system to update the maps and the legal taxes was developed considering these official register data. Author

N88-25953# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
APPLICATION OF 35MM EM AERIAL RECONNAISSANCE PHOTOGRAPHIC FORMAT OF THE MUNICIPALITY OF UBATUBA (SP)
JOAO ROBERTO RODRIGUES *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 180-199 1987
Avail: NTIS HC A14/MF A01

The obtained results and the application possibilities of the photos surpasses the initial expectation of the equipment. This fact points out the necessity of greater detailing in pre-flight planning, to attain the pattern by completing the other possible objectives with a technique utilized and not anticipated in this primary work. On the other hand, the simplicity of the process and cost decrease relative to coverage, indicates a great potential for utilization of this type of monitoring for Municipality City Hall and other entities in small and medium communities of the region, utilizing professional photographs at the proper cities in addition to single engine aircraft of airclubs or rural ownership, having the necessary restrictions to fly without carrying the aircraft remote wing type. It was confirmed that small degree stereoscopic images could be obtained through the mounting of 2 cameras on a support, adequately distanced and endowed drivers with sole command for simultaneous precise discharge. Finally it can be concluded that the production of aerial recognition photography with a 35 mm format fill an important gap in existing sensor resources, in view of the inaccessibility of this most sophisticated technique, has a large number of uses; principally, owing to the limitations imposed through standard image definition, by cost, or by updating of available materials. Author

N88-25954# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING APPLIED TO THE MONITORING OF MINERAL EXTRACTION IN THE PROXIMITY OF URBAN AREAS: PROS AND CONS [SENSORIAMENTO REMOTO APLICADO AO MONITORAMENTO DE EXTRACAO MINERAL EM PROXIMIDADES DE AREAS URBANAS: PROS E CONTRAS]
DALTON DEMORISSONVALERIANO *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 200-210 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

Within the economic activities that are directly related to the exploration of natural resources, quarrying is one of those that causes great environmental disturbances. The lowering of the life qualtiy standard that generally follows environmental degradation justifies the need of a relatively high frequency monitoring of mineral extraction activity when it takes place in urban fringes. Due to its inherent periodicity, spaceborne remote sensing is potencially a fundamental tool to the execution of such monitoring. Nevertheless, due to the operational peculiarities of the activities and to the variability of materials envolved in the mineral extraction, the application of remote sensing to its monitoring requires methological attentions that are specific to each type of quarrying. These methodological aspects are discussed through the analysis of a case study; the coal mining in Southeastern Santa Catarina State. Author

N88-25956# TerraFoto S.A., Sao Paulo (Brazil).
APPLICATION OF INTERACTIVE GRAPHIC SYSTEM (CAD/CAM) IN THE DETERMINATION OF PROCESS EVOLUTION IN LAND USE IN THE RIBEIRAO PRETO MUNICIPALITY
ANTONIO CARLOS CAVALLI *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 232-262 1987
Avail: NTIS HC A14/MF A01

This work has the objective to establish a computerized system which permits storage and recovery of updated information from graphic and nongraphic data in land use in the Sao Paulo State. The base of this work is composed of the comparison of cuts in time, represented through surveying the land use in Ribeirao Preto Municipality accomplished in 1962 through the Instituto Agronomico de Campinas and through photointerpretation of the 1983/84 aerial photos, taken over the same area. The dynamics of land use was evidenced through the intersection of the data of the municipality

soil map with thte transitory and sugar cane cultivation, existing at the time of flight photographs. The method of systematic sampling by grid points was utilized, sighting the system of UTM coordinates, approving the establishment of address geography necessary in the intersection of information. The data thus obtained was processed by an interactive graphics system (CAD/CAM) which permits quantification of space-time evolution in municipal land use. Author

N88-25957# EMPLASA, Sao Paulo (Brazil).
AERIAL PHOTOGRAPHY AS AN INSTRUMENT OF MUNICIPAL AND REGIONAL PLANNING: METROPOLITAN AREA OF SAO PAULO (SP)
FLAVIO SAMMARCOROSA *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 263-279 1987
Avail: NTIS HC A14/MF A01

This work analyzes aerial photography as a more antiquated sensor system and used in Brazil since 1930, citing some of the more important stratifications in the Sao Paulo State. After some conceptual aspects are examined, aerial photography is highlighted as an important resource for obtaining information, connecting the various sciences which study space geography, which affects the survey of natural resources and which analyzes and plans human intervention in the middle atmosphere. The utilization of aerial photography is singled out for the accomplishment of the cartographic base of the municipality or region, as the basis for the implantation and moderization of the municipal cadaster technique and for elaboration of thematic mapping, which offers fundamental information and regional administration. Author

N88-25958# Juruena Empreendimentos de Colonizacao Ltda., Sao Paulo (Brazil).
REMOTE SENSING APPLIED TO INTEGRATED REGIONAL DEVELOPMENT PROGRAMS
JOSE ANTONIO CASANOVASANTOSMATOS *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 280-288 1987
Avail: NTIS HC A14/MF A01

Some of the utilizations of remote sensing, which are routinely used for the elaboration and implantation of the Colonization Project, are cited in generic form. Although it is evident that this utilization is far from being exhausted, excellence is possible by the utilization of this technique, principally facing great dimensions and extreme complexity, which covers the Colonization Project. Therefore, it can be concluded that remote sensing, which today is the fundamental instrument in the Colonization Project, tends to be more and more an element of economic resources, efficiency, and speed of the whole process, contributing to the viability of the initial private participation in the undertakings for integrated regional development. Author

N88-27615# Forschungsinstitut fuer Informationsverarbeitung, Ettlingen (West Germany).
AUTOMATIC LINE NETWORK EXTRACTION FROM AERIAL IMAGERY OF URBAN AREAS THROUGH KNOWLEDGE BASED IMAGE ANALYSIS Interim Report No. 2
H. KAZMIERCZAK 20 May 1987 7 p
(Contract DAJA45-86-C-0049)
(AD-A193067) Avail: NTIS HC A02/MF A01 CSCL 08B

During the past 4 months work has been concentrated on three topics, namely application of road extraction methods to multiresolution test images, application of general segmentation methods to multiresolution test images, and design of a common data bases for all intermediate results. These activities are explained to some detail in this paper. GRA

N88-27643# Oak Ridge National Lab., Tenn.
REVIEW OF GEOGRAPHIC PROCESSING TECHNIQUES APPLICABLE TO REGIONAL ANALYSIS
R. C. DURFEE Feb. 1988 131 p
(Contract DE-AC05-84OR-21400)
(DE88-010759; ORNL/CSD/TM-226) Avail: NTIS HC A07/MF A01

Since the early 1970s regional environmental studies have been carried out at the Oak Ridge National Laboratory using computer-assisted techniques. Presented is an overview of some of these past experiences and the capabilities developed at the Laboratory for processing, analyzing, and displaying geographic data. A variety of technologies has resulted such as computer cartography, image processing, spatial modeling, computer graphics, data base management, and geographic information systems. These tools have been used in a wide range of spatial applications involving facility siting, transportation routing, coal resource analysis, environmental impacts, terrain modeling, inventory development, demographic studies, water resource analyses, etc. The report discusses a number of topics dealing with geographic data bases and structures, software and processing techniques, hardware systems, models and analysis tools, data acquisition techniques, and graphical display methods. Numerous results from many different applications are shown to aid the reader interested in using geographic information systems for environmental analyses. DOE

N88-28358 Chiba Univ. (Japan). Remote Sensing and Image Research Center.
REVIEW OF THE STUDIES OF GEOGRAPHY AND ENVIRONMENT AND STUDIES ON SPECTRAL CHARACTERISTICS OF SPOT HRV DATA
KIYOSHI TSUCHIYA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 131-137 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT in studies of the geography and environment, and the analysis of spectral characteristics over the area of complicated land use and land cover is reviewed. Land cover classification, sand transport in a desert, an analysis and modeling of disturbed lands, Antarctic sea ice, and earthquake hazard zoning are covered. All the tests indicate usefulness of high resolution SPOT HRV data. The analysis of spectral characteristics over the area of complicated land use in Tokyo and Yokohama areas indicate spatial and spectral resolutions higher than those of SPOT HRV and desired for land use classification to the degree of the detailed digital geographical information system adopted. ESA

N88-28364 Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris (France).
LAND USE SYSTEMS AND RURAL LANDSCAPES IN THE CENTER OF VERACRUZ STATE (MEXICO): FIRST RESULTS
LUC CAMBREZY, REGINE CHAUME, ODILE HOFFMANN, and RAFAEL PALMA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 191-198 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Substitution of satellite imagery for aerial photography reconnaissance and analysis of physical conditions in rural areas was tested using two SPOT panchromatic images of an extremely diversified region of Mexico. The intention was to integrate satellite data on land use, vegetation, agricultural systems, and morphology in a geographic information system. Results are very uneven, depending on the theme considered, because of the heterogeneity of the area and methodological difficulties. ESA

N88-28366 National Air and Space Museum, Washington, D.C. Center for Earth and Planetary Studies.
DISCRIMINATION OF SAND TRANSPORT RATES AND ENVIRONMENTAL CONSEQUENCES IN CENTRAL EGYPT FROM SPOT DATA
TED A. MAXWELL and PRISCILLA L. STRAIN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 209-214 1988
(Contract NAS5-28774)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Three SPOT images from the largest longitudinal dune complex

of the Western Desert of Egypt were used to discriminate zones of sand infringement on agricultural and other inhabited regions, and to document dune migration rates over a 14 yr period. In the Bahariya region, increased use of active sand surfaces for agriculture is observed, as well as the development of vegetation wind breaks to stabilize sand within a village. The northern part of the Ghard Abu-Muharik dune complex consists of individual longitudinal dunes that shift in response to seasonal wind directions, as shown by comparison of 1986 SPOT data with LANDSAT images from 1972 and 1984, and air photographs from 1944. At the resolution of the orbital data, no lengthening of the individual dunes is observed. In the central part of the Abu-Muharik, spectral reflectance differs between the active, lighter-toned western dunes, and the more stable, redder seifs of the eastern part of the complex. Such differences are consistent with observations of active dune movement in the west, and relatively stable dunes in the east. The southern terminus of the dune complex consists of individual barchan dunes that migrate southward through the Kharga depression. Here, dune movement of 60 to 220 m is measured by coregistration of SPOT and 1972 LANDSAT MSS data. ESA

N88-28368 Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris (France).
FOLLOWING THE SEASONAL EVOLUTION OF A NATURAL ENVIRONMENT IN A HUMID TROPICAL REGION. PRELIMINARY EVALUATION OF SPOT (PEPS) NUMBER 186: BANGUI, CENTRAL AFRICA [SUIVI DE L'EVOLUTION SAISONNIERE D'UN MILIEU NATUREL DE REGION TROPICALE HUMIDE. PEPS N. 186: BANGUI - CENTRALE AFRIQUE]
THIERRY SIMON, MICHEL SOURDAT, RENZO VERCESI, and YVES BOULVERT *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 221-228 1988 In FRENCH; ENGLISH summary Original contain color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The evolution of a humid tropical region was studied using seasonally spaced SPOT images. The test area represents the transition zone between equatorial and tropical climates, dense forest and savannah, and urban and village areas and nomadic regions. It has a very short dry season and low relief. Results show the extreme utility of SPOT imagery for resources management in large tropical areas if certain conditions are met. Acquisition times must be carefully chosen to avoid meteorological and anthropometric artefacts. Ground truth must be acquired quasi-simultaneously and be defined according to criteria compatible with HRV characteristics. ESA

N88-28376 National Aerospace Lab., Amsterdam (Netherlands).
THE SUITABILITY OF SPOT IMAGERY FOR MONITORING LANDSCAPE PATTERNS
J. M. J. FARJON, P. G. LENTJES, F. B. VANDERLAAN (National Aerospace Lab., Amsterdam, Netherlands), and W. J. C. HOEFFNAGEL *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 295-302 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In order to determine whether the application of SPOT imagery removes the limitations of traditional data sources, research was done to ascertain the detectability of linear landscape patterns, such as line plantings and watercourses. The results show that 60 to 70 percent of these patterns are detected on an optimal SPOT image composed of panchromatic and MSS bands. The limit of the actual spectral resolution lies at 5 m. Width and tree species have a major influence on the detectability of line plantings, orientation and context only a minor. Possibilities for application of SPOT imagery in landscape planning are discussed. ESA

N88-28396 Laboratoire Central des Ponts et Chaussees, Paris (France).
USE OF SPOT DATA IN PRELIMINARY STEPS OF ROAD PROJECT STUDIES ESPECIALLY SUITED FOR DEVELOPING COUNTRIES
J. L. BUISSON, I. DESTIVAL, M. DORIDOT, M. PAUSADER, and J. C. VILLEMAUD (Service d'Etudes Techniques des Routes et Autoroutes, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 483-490 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The use of SPOT imagery to determine the general axis of new roads in developing countries was studied. A system based on classical photointerpretation of stereo images was adopted, since it is assumed that users do not have access to sophisticated image analysis systems. Image scale is 1:100,000 and panchromatic images are preferred to the XS product, because of their better resolution. A zooming capacity for image transfer enables the commonly used 1:50,000 and 1:25,000 scales to be obtained. By superposing a map of landmarks (hydrology, road networks) on to a slope map, a useful tool for engineers in the field is obtained. By continuing the processing, geological and textural features can be derived. A hydrogeological map for, e.g., planning bridges can be produced. ESA

N88-28397 Waterloo Univ. (Ontario). Faculty of Environmental Studies.
SPOT IMAGERY FOR DETECTING RESIDENTIAL EXPANSION ON THE RURAL-URBAN FRINGE OF TORONTO, CANADA
PHILIP J. HOWARTH, LARRY R. G. MARTIN, GLENN H. HOLDER, DOUGLAS D. JOHNSON, and JINFEI WANG *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 491-498 1988 Sponsored in cooperation with BILD, Ontario, and WATDEC Original contains color illustrations
(Contract NSERC-A0766)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It is shown that rural-to-urban land conversion can readily be identified using SPOT MLA and PLA imagery. It is possible to visually identify details within areas of residential construction which indicate rates of development of new subdivisions. Supervised classification of SPOT MLA data produces results comparable in accuracy to results from LANDSAT MSS data, at the same level of classification. However, the data can be classified at more detailed levels than MSS data, but accuracies vary depending on the cover type. Enhancement and classification of multidate images permits good accuracy in the identification of change at the rural-urban fringe. ESA

N88-28399 Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris (France).
UTILIZATION OF REMOTE SENSING FOR THE OBSERVATION OF URBAN POPULATIONS. ONGOING RESEARCH IN QUITO (ECUADOR) [L'UTILISATION DE LA TELEDECTION POUR L'OBSERVATION DES POPULATIONS URBAINES. UNE RECHERCHE EN COURS A QUITO (EQUATEUR)]
ALAIN MICHEL, JEAN-MICHEL EBERHARD, BERNARD LORTIC, and FRANCOISE DUREAU (Institut Francais de Recherche pour le Developpement en Cooperation, Quito, Ecuador) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 505-514 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A permanent urban population observation system dealing with information coming from high resolution satellites (SPOT and Thematic Mapper) is proposed. Satellites inform continuously about urban land use. The method consists of using this exhaustive information on urban morphology to quickly collect, by sample survey, urban population data. Work on aerial photographs shows the efficacy of this principle. A better knowledge of urban areas coming from satellite pictures constitutes an important improvement in demographic sample survey systems to establish a complete and updated survey base, to optimize the survey by using urban morphologic information, and to obtain localized results according to a significant sectioning of the city. ESA

N88-28400 Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Lab. d'Etudes et de Recherches en Teledetection Spatiale.
INTEGRATION OF SPOT DATA INTO A GEOCODED INFORMATION SYSTEM [INTEGRATION DES DONNEES SPOT A UN SYSTEME D'INFORMATIONS GEOCODEES]
CATHERINE PEDRON, JEAN CUSSOL, JACQUES TOURNET, and CATHERINE LEPRIEUR *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 515-530 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT data for urban management is illustrated. Data are used to keep track of construction work, compute runoff for each urban watershed automatically, and help manage water resources. The system is based on a micro workstation. ESA

N88-28402 Haut Commissariat a la Recherche, Algiers (Algeria).
PRELIMINARY COMPARATIVE ANALYSIS OF LANDSAT AND SPOT DATA FOR THE STUDY OF THE SANDING PHENOMENON: ZAAFRANE REGION (ALGERIA) [PREMIERE ANALYSE COMPARATIVE DES DONNEES LANDSAT ET SPOT POUR L'ETUDE DU PHENOMENE D'ENSABLEMENT: REGION ZAAFRANE]
D. YOUSFI, A. OUSSEDIK, and M. KERMAD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 541-550 1988 In FRENCH Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Sand transport by the wind in a semi-arid region was studied using satellite imagery. Comparison of LANDSAT 5 and SPOT classification algorithms reveals the limits of LANDSAT due to its spatial resolution. The SPOT data allow the type of dune to be identified, thereby completing LANDSAT data on the zones of sand transport initiation and termination to be completed. The combined data can be used to identify dunes likely to be shifted by the wind. ESA

N88-28403 Environment Canada, Dartmouth (Nova Scotia).
AN EVALUATION OF THE APPLICABILITY OF SPOT STEREOSCOPIC IMAGERY TO THE CANADA LAND USE MONITORING PROGRAM (CLUMP)
D. A. WILSON, M. L. MCCOURT, M. POIRIER, and J. SEEL (Atlantic Canada Airborne Sensing, Inc., Debert, Nova Scotia) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 551-557 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Practical recommendations, specifically regarding the use of SPOT film and digital products within Environment Canada's national land use monitoring program and the related regional programs of the other agencies involved in the study are established. The use of a single SPOT data source is recognized as a means of facilitating interagency cooperation. It is proposed that: (1) Given the superior results afforded by the visual products, that SPOT positive film transparency stereo-pairs; summer (P) plus fall (XS), both extreme off-nadir views, be used to update the 70 urban centred regions, and detect change in the Agricultural Land Survey. (2) That panchromatic stereo-pairs be used to detect change in the linear extent and concentration of buildings in the rural areas of Nova Scotia. (3) That portions of the Canada Land Inventory be updated with the focus on (dictated by cost) SPOT tridimensional film products, but that future effort be directed toward the digital links established between remotely sensed data analysis and the geographic information system environments with the proposed SPOT vegetation sensor in mind. ESA

N88-28404 Remote Sensing Applications Centre, Bangor (Wales).
TOPOGRAPHIC SUPPRESSION AND ADVANCES IN CLASSIFICATION FOR LAND COVER MAPPING USING SPOT-1 HRV IMAGERY
B. WYATT, A. JONES, J. SETTLE, J. TOWNSHEND, J. BAKER, and S. BRIGGS (Royal Aircraft Establishment, Farnborough, England) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 559-566 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from HRV sensors onboard the SPOT-1 satellite were utilized for classifying seminatural land cover. Two methods for improving classification performance are discussed, namely the use of digital terrain information to reduce topographic effects on spectral information and the extraction of training data from image plane and feature space. Promising results are achieved. However, low classification accuracies suggest that spectral classification alone is insufficient in the mapping of seminatural cover types. ESA

N88-28406 Reading Univ. (England). NERC Unit for Thematic Information Systems.
MONITORING URBAN LAND COVER CHANGES AT THE URBAN FRINGE FROM SPOT HRV IMAGERY IN SOUTH-EAST ENGLAND
N. A. QUARMBY, J. R. G. TOWNSHEND, and J. L. CUSHNIE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 575-582 1988 Original contains color illustrations
(Contract NERC-F60/G6/12)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Digital change detection to monitor urban land use with SPOT is discussed. It is shown that change detection techniques can be used to delineate areas of change in land use from rural to urban developments and to monitor gravel extraction and land reclamation. The procedure is best suited to the detection of annual change or medium-term changes. The addition of other sources of geographic information can be used to improve the accuracy of the change detection technique and to improve the interpretability of the change image or enhanced false color composite image. ESA

N88-28410 Tokai Univ., Kanagawa (Japan). Research and Information Center.
ACCURACY OF LAND USE CLASSIFICATION FOR SPOT IMAGE DATA
HARUHISA SHIMODA and TOSHIBUMI SAKATA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 631-636 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Satellite (SPOT, LANDSAT) imagery of land use in an area 2 km by 10 km containing cities, agriculture, forest, rivers, and the sea was assessed. The real classification accuracies for land use/cover using maximum likelihood classifier are not so good as estimated by using training data. Average accuracies are in the range of 60 to 70 percent. The increase of spatial resolution does not necessarily result higher classification accuracies. In order to fully utilize the increased performance of high resolution sensors, spatial information in the image should be properly analyzed. On the whole, TM and HRV data show same level classification accuracies for land use/cover. ESA

N88-28414 KRS Remote Sensing, Mich.
APPLICATIONS OF SPOT DATA FOR URBAN REAL ESTATE INVESTMENT INFORMATION SYSTEMS
DONALD R. MORRIS-JONES, MICHALE ROBBINS, CRAIG HUNGERFORD, MICHAEL MILES, and JOHN COLWELL (Environmental Research Inst. of Michigan, Ann Arbor.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 661-667 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The utility of SPOT data for urban land use mapping was assessed using images prepared with different change detection techniques. A real estate market analysis using remote sensing and other data sources was performed. Results show that SPOT panchromatic and SPOT modulated panchromatic and multispectral images provided a dramatically improved land use mapping

capability, especially in suburban areas, relative to LANDSAT MSS and TM images. Comparison of 1974 LANDSAT MSS images with 1986 SPOT images provides an impressive ability to monitor urban growth in Denver over the period. Multidate 1982 LANDSAT TM and 1986 SPOT images of North Carolina prepared with various techniques provide useful single image displays of changes in land cover and land use. Interpretation of SPOT images is very useful in performing an improved market analysis of a shopping center providing a means to better determine the demographic profile and retail sales of a 1.5 mile radius of the property. ESA

N88-28415 New South Wales Univ., Sydney (Australia). Center for Remote Sensing.
MAPPING AND URBAN MULTI-EXPERIMENTAL ASSESSMENT OF SPOT: URBAN RESULTS
B. C. FORSTER, C. SMITH, R. FARRINGTON, and C. JONES *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 669-674 1988 Sponsored by the Australian Research Grant Scheme and the Department of Administrative Services, Canberra, Australia
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Applications of spaceborne sensor data to urban areas were extended using SPOT 10 m resolution P mode and 20m resolution XS mode, and results were compared with those of SIR-B, LANDSAT TM, and LANDSAT MSS data. Thirty sampling sites were selected and ground truthed over a city using a sampling grid that allows the nesting together of the various remotely sensed data sets. Applications include urban fringe monitoring, discrimination of land use classes, prediction of residential housing density, estimation of urban quality measures, incorporation of ancillary property boundary data, estimation of socio-economic variables, and population density. Results indicate that housing density can be predicted over a 60 by 60m cell with a correlation of greater than 0.6. ESA

N88-28416 Department of Scientific and Industrial Research, Lower Hutt (New Zealand).
SPOT-1 OVER NEW ZEALAND: ANALYSIS OF SPOT IMAGERY FOR LAND USE INVESTIGATIONS
S. E. BELLISS, P. R. STEPHENS, I. MCINDOE, K. MUSCROFT-TAYLOR, G. WARD, and P. F. NEWSOME (Ministry of Works and Development, Palmerston North, New Zealand) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 675-680 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Experiments with SPOT data in three different rural environments show that identification and quantification of land cover and land use may be achieved with levels of accuracy acceptable for most routine investigations. Results are best on areas of low or no relief; in hilly areas, variable illumination gives problems, most of which might be overcome by the use of digital terrain models, themselves able to be derived from SPOT stereo pairs. Experiments concentrated upon the use of SPOT imagery to identify pasture and crop types, forestry types, bare ground and landslide extent, areas of native vegetation, and noxious weed infestation. ESA

N88-28417 National Physical Research Lab., Pretoria (South Africa).
COMPARISON OF SPOT, LANDSAT TM AND COMBINED DATA FOR URBAN STUDIES
O. G. MALAN, P. F. ERASMUS (Rand Afrikaans Univ., Johannesburg, South Africa), and C. FOURIE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 681-687 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT and LANDSAT Thematic Mapper (TM) were used to map land use patterns in urban areas. For both types of multispectral data a semisupervised classification technique is used. In order to define the spectral signatures of the relevant cover types, a selected subsample of the full scene is subjected to an iterative cluster analysis, which is a modification of ISODATA of Ball and Hall. Spectral domination of classes which are over-represented in the scene is avoided by this method and desired classes are automatically identified in the natural grouping of the clusters. Through an iterative process the subsample is reselected until a classification well representative of all land cover classes in the study area is obtained. A map of cover classes does not necessarily result in a useful map of urban classes. The cover classes are therefore classified into urban classes by a special supervised classification. This classification differs from the conventional in that the features are spectral frequencies within a window in geographic space, rather than radiances. The product is an objective map of urban land use classes coinciding with the visual patterns shown by cover classes. Panchromatic SPOT imagery and derivatives, as well as map data were combined with classified multispectral SPOT and TM data through a color transformation to produce simplifying visual analysis. ESA

N88-28418 Technische Univ., Hanover (West Germany). Inst. for Photogrammetry and Engineering Surveys.
UTILIZATION OF SPOT MULTISPECTRAL DATA FOR URBAN PLANNING
P. LOHMANN and G. ALTROGGE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 689-697 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The effect of the structure of urban areas and land use on the environment was studied by remote sensing. Use of SPOT multispectral data is evaluated in combination with high altitude photography and thematic maps. Color transformations are used to differentiate between sealed and vegetation areas together with hierarchical classification methods. Eight major land use categories for the city area and another 15 for agricultural areas are obtained. ESA

N88-28440 Nice Univ. (France). Lab. de Geologie Geochimie.
SPOT IMAGERY FOR LANDSLIDE CARTOGRAPHY IN MOUNTAINOUS AREAS. EXAMPLE OF THE FRENCH MARITIME ALPS
R. CAMPREDON, R. MARTINEZ, J. P. MENEROUD, and O. DEMONTAUZAN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 887-893 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The SPOT 1 capability to discriminate potential landslide areas was assessed. Process images of the test site are in good agreement with field and aerial photo data and offer the possibility to set up a provisional map of the potential landslide areas. ESA

N88-29225# Oak Ridge National Lab., Tenn.
REGIONAL ENVIRONMENTAL STUDIES USING NATIONAL DATA BASES AND GIS (GEOGRAPHIC INFORMATION SYSTEM)
R. J. OLSON, R. A. MCCORD, K. C. DEARSTONE, and S. P. TIMMINS 1988 18 p Presented at the 8th ESRI Annual User Conference, Palm Springs, Calif., 21 Mar. 1988 Prepared in cooperation with Analysas Corp., Oak Ridge, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-008368; CONF-880385-1) Avail: NTIS HC A03/MF A01

The Environmental Sciences Division at Oak Ridge National Laboratory has conducted a variety of regional and national studies of potential environmental impacts related to energy development. These studies have included the assessment of acid deposition impacts, assessment of global climate change, environmental impact and risk analysis, and landscape pattern analysis. We have compiled the Geoecology and ADDNET data bases for regional studies. These data bases contain extensive national data regarding soils, land use, agriculture, forestry, aquatic resources, endangered species, natural areas, air quality, emissions, and climate. SAS is used for data management, analysis, and display. An in-house

geographic information system (GIS) is also used for mapping. In 1986 we acquired the ARC/INFO system to enhance our GIS capabilities and to be compatible with other federal agencies. Our evaluation of lake chemistry data from the Environmental Protection Agency's National Surface Water Survey demonstrates the use of GIS as a tool for regional studies. In addition, the interfacing of SAS data sets and ARC/INFO attribute files is discussed. DOE

N88-29233*# National Aeronautics and Space Administration, Washington, D.C.
PRESENT STATE OF KNOWLEDGE OF THE UPPER ATMOSPHERE 1988: AN ASSESSMENT REPORT
R. T. WATSON, M. J. PRATHER, and M. J. KURYLO Jun. 1988 203 p
(NASA-RP-1208; NAS 1.61:1208) Avail: NTIS HC A10/MF A01 CSCL 04A

This document was issued in response to the Clean Air Act Amendments of 1977, Public Law 95-95, mandating that NASA and other key agencies submit biennial reports to Congress and EPA. NASA is to report on the state of our knowledge of the upper atmosphere, particularly the stratosphere. This is the sixth ozone assessment report submitted to Congress and the concerned regulatory agencies. Part 1 contains an outline of the NASA Upper Atmosphere Research Program and summaries of the research efforts supported during the last two years. An assessment is presented of the state of knowledge as of March 15, 1988 when the Ozone Trends Panel, organized by NASA and co-sponsored by the World Meteorological Organization, NOAA, FAA and the United Nations Environment Program released an executive summary of its findings from a critical in-depth study involving over 100 scientists from 12 countries. Chapter summaries of the International Ozone Trends Panel Report form the major part of this report. Two other sections are Model Predictions of Future Ozone Change and Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling. Each of these sections and the report in its entirety were peer reviewed. Author

N88-29248# Lawrence Livermore National Lab., Calif.
REGIONAL INTERCOMPARISONS OF GENERAL CIRCULATION MODEL PREDICTIONS AND HISTORICAL CLIMATE DATA: CO2
S. L. GROTCH Apr. 1988 307 p
(Contract W-7405-ENG-48)
(DE88-010416; DOE/NBB-0084) Avail: NTIS HC A14/MF A01

This study is a detailed intercomparison of the results produced by four different General Circulation Models (GCMs) used to project the climatic consequences of a doubling of the atmospheric CO2 concentration. The results for the models developed by groups at the National Center for Atmospheric Research, the Geophysical Fluid Dynamics Laboratory of NOAA, and the Goddard Institute for Space Studies of NASA have been described by Schlesinger and Mitchell (1985) in the DOE state-of-art (SOA) report, Projecting the Climatic Effects of Increasing Carbon Dioxide. The fourth model examined here is the Oregon State University GCM, results for which did not become available until after publication of the SOA. We have chosen to examine only two model variables here: (1) surface air temperature, and (2) precipitation. We consider these variables for both seasonally and annually averaged periods, for both the current climatic conditions and the predicted equilibrium changes after a doubling of the CO2 concentration. The major conclusion is that, although the models often agree well comparing seasonal or annual averages over the large areas, substantial disagreements become apparent as the spatial extent is reduced, particularly when detailed regional distributions are examined. At scales below continental, the correlations observed between different model predictions are often very poor, particularly for land gridpoints during the Northern Hemisphere (NH) summer, with differences of as much as 5 C between models and observations and between one model and another over relatively large areas. DOE

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography.

A88-50763
ISOSTASY AND THE GRAVITY FIELD OF THE NORTH ATLANTIC [IZOSTAZIIA I GRAVITATSIONNOE POLE SEVERNOI ATLANTIKI]
M. E. ARTEM'EV, T. M. BABAEVA, I. E. VOIDETSKII, V. M. GORDIN, and V. O. MIKHAILOV Moscow, VINITI, 1987, 156 p. In Russian. refs

In the course of the analysis of literature data on the gravity field of the North Atlantic and adjacent continents, a local component of the field corresponding to anomalous masses located above the isostatic compensation level was isolated. The isostatic anomaly field could be separated, by statistical criteria, into three components: one with wavelengths exceeding 2500 km, the second equal to about 1500 km, and the third shorter than 1000 km. The analysis of local Glenny anomalies and the data on the earth's crust structure in the North Atlantic made it possible to distinguish such characteristics of the subcrustal layer as the decrease in its density under the mid-Atlantic ridge, and its higher density under the western basins of the ocean relative to the eastern basins. A new model of the evolution of Atlantic-type ocean margins, which takes into account the isostasy, sedimentation, bottom topography characteristics, and rheological features of the crust and the subcrustal layer, is presented. I.S.

A88-50776
RECENT CRUSTAL MOVEMENTS: MORPHOSTRUCTURE, FAULTS, SEISMICITY [SOVREMENNYE DVIZHENIIA ZEMNOI KORY: MORFOSTRUKTURY, RAZLOMY, SEISMICHNOST']
IU. D. BULANZHE, ED., D. A. LILIENBERG, ED., L. E. SETUNSKAIA, ED., and S. V. ENMAN, ED. Moscow, Izdatel'stvo Nauka, 1987, 200 p. In Russian. No individual items are abstracted in this volume.

This symposium includes papers given at an All-Union conference on recent crustal movements, together with the results in this area from international papers. Topics discussed include general problems; the mapping of recent crustal movements; morphostructural differentiation, faults, and seismicity; studies of recent geodynamics using continuous methods; and measurement and processing techniques. Papers are presented on current problems of global dynamics; on the map of recent vertical crustal movements on Soviet territory, compiled from geodetic data; the compilation of the velocity map of recent vertical crustal movements on the western Siberian plate; the recent morphostructural geodynamics of Moldavia; and the relationship between the vertical movements of the Kazakh shield and its morphostructural plan. Consideration is also given to a study of slow crustal tilts at the Poltava Gravimetrical Observatory, the wide-range self-compensating tiltmeter and its advantages when studying recent crustal movements, and the methods and software used for the description of crustal deformation fields from geodetic data. I.S.

A88-55020
THE GRAVITY GRADIOMETER SURVEY SYSTEM (GGSS)
CHRISTOPHER JEKELI (USAF, Geophysics Laboratory, Hanscom AFB, MA) EOS (ISSN 0096-3941), vol. 69, Feb. 23, 1988, p. 105, 116, 117. refs

The Gravity Gradiometer Survey System (GGSS), which measures the earth's gravity field, using gradient measurements to separate linear kinematic and gravitational accelerations, is discussed. The history of the development of the GGSS and an overview of its operation are given. The pendulous force rebalance accelerometer which is the main measuring device in the GGSS is examined and illustrated. The ancillary components of the system and GGSS data processing techniques are considered. Results of

tests of the GGSS are presented, showing that it correctly senses all of the independent gradients of the gravity field at longer wavelengths. R.B.

N88-30196# Analytic Sciences Corp., Reading, Mass.
ESTIMATION OF SHORT-WAVELENGTH GRAVITY ON A DENSE GRID USING DIGITAL TERRAIN ELEVATION DATA
Scientific Report No. 1, May 1986 - May 1987
J. D. GOLDSTEIN, J. V. WHITE, R. P. COMMER, and W. G. HELLER Oct. 1987 41 p
(Contract F19628-86-C-0077)
(AD-A196325; ANSER-TR-5362-1; AFGL-TR-0280) Avail: NTIS HC A03/MF A01 CSCL 08E

The precise determination of the gravity field at or near the earth's surface is required for compensating navigation/guidance systems and for testing gravity gradiometers. With conventional gravimeters it is usually impractical to measure the gravity field over an extended area at very short wavelengths (e.g., wavelengths less than 10 km). Since very short-wavelength gravitational perturbations at the surface are caused largely by near-surface mass variations in the local area, and since digital terrain elevation data (DTED) are available on dense grids (e.g., three arc second spacing) for selected regions, the very short-wavelength components of gravity can be estimated without a gravity survey by using the DTED and the assumption of constant mass density. This report presents an approach to computing the short-wavelength, terrain-induced gravity field at a prescribed rms accuracy. For a relatively flat test area in Oklahoma, the rms effect of terrain elevation on the gravity field at mean elevation for wavelengths shorter than 10 km varies between 0.6 mgal and 2.2 mgal. The largest point value of the high-frequency terrain effect is 18.0 mgal. GRA

N88-30248*# Lunar and Planetary Inst., Houston, Tex.
GRAVITY ANOMALIES, PLATE TECTONICS AND THE LATERAL GROWTH OF PRECAMBRIAN NORTH AMERICA
M. D. THOMAS, R. A. F. GRIEVE (Geological Survey of Canada, Ottawa, Ontario), and V. L. SHARPTON *In its* Workshop on the Growth of Continental Crust p 153-155 1988
Avail: NTIS HC A08/MF A01 CSCL 08G

The widespread gravity coverage of North America provides a picture of the gross structural fabric of the continent via the trends of gravity anomalies. The structural picture so obtained reveals a mosaic of gravity trend domains, many of which correlate closely with structural provinces and orogenic terranes. The gravity trend map, interpreted in the light of plate-tectonic theory, thus provides a new perspective for examining the mode of assembly and growth of North America. Suture zones, palaeosubduction directions, and perhaps, contrasting tectonic histories may be identified using gravity patterns. Author

N88-30527# Joint Publications Research Service, Arlington, Va.
ANALYTICAL METHOD FOR APPROXIMATE GEODETIC REFERENCING OF SCANNER IMAGES OF METEOROLOGICAL ARTIFICIAL EARTH SATELLITES USING CONTROL POINTS
Abstract Only
M. V. IVANCHIK and V. A. KROVOTYNTSEV *In its* JPRS Report: Science and Technology. USSR: Space p 23 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 3, May - Jun. 1987 p 109-115 Original language document was announced in IAA as A88-10923
Avail: NTIS HC A04/MF A01

A georeferencing method is proposed which relies on the coordinates of characteristic reference points on space images, the orbital inclinations and the satellite revolution period. The method does not require the satellite trajectory data input, and the algorithms of the procedure are simple and compact, making it possible to program a problem with a small expenditure of the computer time for image processing. The correlating accuracy of the method is + or - 20 to 30 km. Author

04

GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

A88-46068
SPACE-GEOLOGICAL MAPPING OF THE USSR [KOSMOGEOLOGIIA SSSR]
V. N. BRIUKHANOV, ED. and N. V. MEZHELOVSKII, ED. Moscow, Izdatel'stvo Nedra, 1987, 240 p. In Russian. No individual items are abstracted in this volume.

This work examines the theoretical and methodological principles underlying the use of satellite remote sensing data to compile geological maps. A 1:2,500,000-scale space-geological map of the Soviet Union is characterized, and a new interpretation of the geological evolution of large regions of the country is presented. The possible use of space-geological maps for tectonic, geodynamic, and mineralogical investigations is assessed. B.J.

A88-46285* Open Univ., Milton (England).
VOLCANO MONITORING USING SHORT WAVELENGTH INFRARED DATA FROM SATELLITES
D. A. ROTHERY (Open University, Milton Keynes, England), P. W. FRANCIS (Lunar and Planetary Institute, Houston, TX), and C. A. WOOD (NASA, Johnson Space Center, Houston, TX) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, July 10, 1988, p. 7993-8008, 8087. refs
(Contract NAS5-28759; NASW-4066)

It is shown that Landsat TM and MSS data provide useful and sometimes unique information on magmatic and fumarolic events at poorly monitored active volcanoes. The digital number data recorded in each spectral band by TM and MSS can be converted into spectral radiance, measured in W/sq m per micron per sr, using calibration data such as those provided by Markham and Barker (1986) and can provide temperature information on the lava fountain, lava lakes, pahoehoe flows, blocky lava, pyroclastic flow, and fumarole. The examples of Landsat data documenting otherwise unobserved precursors and/or activity include the September 1986 eruption of Lascar volcano, Chile; the continued presence of lava lakes at Erta 'Ale, Ethiopia (in the absence of any ground-based observations); and minor eruptions at Mount Erebus, Antarctica. I.S.

A88-46351
THE GEOLOGY OF THE DAMASCAS REGION (SYRIA) FROM STEREOSCOPIC SPOT 1 IMAGES [LA GEOLOGIE DE LA REGION DE DAMAS (SYRIE) D'APRES DES IMAGES STEREOSCOPIQUES DE SPOT 1]
J. GUILLEMOT (Ecole Nationale Superieure du Petrole et des Moteurs, Rueil-Malmaison, France) Photo Interpretation (ISSN 0031-8523), vol. 26, Mar.-Apr. 1987, p. 1-9, 11, 13, 15. In French, English, and Spanish.

A88-46352
STEREOSCOPIC SPOT 1 IMAGES OF THE EVEREST REGION (KHUMBA HIMAL) [IMAGES SPOT 1 EN STEREOSCOPIE DE LA REGION DE L'EVEREST /KHUMBA HIMAL/]
M. FORT (Paris XIII, Universite, Villetaneuse, France) Photo Interpretation (ISSN 0031-8523), vol. 26, Mar.-Apr. 1987, p. 17-21, 23, 25, 27. In French, English, and Spanish.

A88-46356
STRUCTURAL INTERPRETATION OF LANDSAT IMAGES AND MINERAL PROSPECTING - CHARACTERIZATION OF 'LINEAMENT CORRIDORS' IN A TIN AND TUNGSTEN METALLOGENIC PROVINCE (EXTREMADURA, SPAIN) [INTERPRETATION STRUCTURALE D'IMAGES LANDSAT ET PROSPECTION MINIERE - CARACTERISATION DE 'COULOIRS LINEAMENTAIRES' DANS UNE PROVINCE METALLOGENIQUE A ETAIN ET TUNGSTENE /ESTREMADURE, ESPAGNE/]
CL. GAGNY (Nancy I, Universite, Vandoeuvre, France) and B. MARCONNET (Teledetection et Geologie Service, Colomiers, France) Photo Interpretation (ISSN 0031-8523), vol. 26, July-Aug. 1987, p. 1-5, 7. In French, English, and Spanish.

A88-46766* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MULTISENSOR CLASSIFICATION OF SEDIMENTARY ROCKS
DIANE EVANS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, July 1988, p. 129-144. refs

A comparison is made between linear discriminant analysis and supervised classification results based on signatures from the Landsat TM, the Thermal Infrared Multispectral Scanner (TIMS), and airborne SAR, alone and combined into extended spectral signatures for seven sedimentary rock units exposed on the margin of the Wind River Basin, Wyoming. Results from a linear discriminant analysis showed that training-area classification accuracies based on the multisensor data were improved an average of 15 percent over TM alone, 24 percent over TIMS alone, and 46 percent over SAR alone, with similar improvement resulting when supervised multisensor classification maps were compared to supervised, individual sensor classification maps. When training area signatures were used to map spectrally similar materials in an adjacent area, the average classification accuracy improved 19 percent using the multisensor data over TM alone, 2 percent over TIMS alone, and 11 percent over SAR alone. It is concluded that certain sedimentary lithologies may be accurately mapped using a single sensor, but classification of a variety of rock types can be improved using multisensor data sets that are sensitive to different characteristics such as mineralogy and surface roughness. Author

A88-48106
THE LOCATION OF LATE CRETACEOUS BASALTOIDS IN THE STRUCTURE OF THE UL'INSKII DEPRESSION IN THE NORTH OKHOTSK REGION [POLOZHENIE POZDNEMELOVYKH BAZAL'TOIDOV V STRUKTURE UL'INSKOGO PROGIBA /SEVERNOE PRIOKHOT'E/]
A. S. SINDEEV and S. I. STREL'NIKOV (Vsesoiuznyi Nauchno-Issledovatel'skii Geologicheskii Institut, Leningrad, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 300, no. 4, 1988, p. 919-923. In Russian. refs

The location of shoshonite lava fields in the structure of the Ul'inskii depression is investigated on the basis of space photographs of different scale. It is shown that Late Cretaceous shoshonite volcanism is the final stage of a unified and continuous tectonic-magmatic process within the active confines of the Asian paleocontinent. B.J.

A88-48448
IMAGE PROCESSING OF AEROMAGNETIC DATA AND INTEGRATION WITH LANDSAT IMAGES FOR IMPROVED STRUCTURAL INTERPRETATION
WILLIAM S. KOWALIK (Chevron Oil Field Research Co., La Habra, CA) and WILLIAM E. GLENN (Chevron Canada Resources, Ltd., Toronto, Canada) ITC Journal (ISSN 0303-2434), no. 4, 1987, p. 305-313. refs

Several digital image processing techniques for enhancing aeromagnetic and Landsat data are evaluated with the goal of producing an improved structural interpretation. The techniques used in the study include presentation as small-scale, grey-level images, contrast enhancement, artificial illumination, and directional filtering. Landsat images of three regions were registered to the aeromagnetic data sets for those regions. The Landsat images showed structural patterns which did not appear in the aeromagnetic data and vice versa. It is concluded that the integration of aeromagnetic and Landsat data acquired over mineral prospects can lead to better structural interpretation. R.B.

A88-49363* Arizona State Univ., Tempe.
RADAR OBSERVATIONS OF BASALTIC LAVA FLOWS, CRATERS OF THE MOON, IDAHO
RONALD GREELEY and LINDA MARTEL (Arizona State University, Tempe) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1071-1085. refs
(Contract NCC2-346; NSG-7415)

Radar images of Craters of the Moon, Idaho were used to study the backscatter characteristics of basaltic lava flows of predominantly pahoehoe textures and to determine the ability to detct fissure vents. Four images were obtained: X-band HH, X-band HV, L-band HH, and L-band HV. Hummocky pahoehoe flows were found to have strong backscatter in all four of these images. Aa lava flows showed the greatest variation in backscatter intensities, due to an increase in multiple scattering at the L-band scale. Eruptive fissures are detectable in the radar images by virtue of associated parallel spatter ramparts which have diagnostic, strong backscatter in the X-band images that are in contrast to the weak backscatter of the surrounding shelly pahoehoe lava. The importance of look direction in the use of radar images to characterize terrains is emphasized. R.B.

A88-49398* Massachusetts Inst. of Tech., Cambridge.
STRIKE-SLIP FAULT GEOMETRY IN TURKEY AND ITS INFLUENCE ON EARTHQUAKE ACTIVITY
A. A. BARKA and K. KADINSKY-CADE (MIT, Cambridge, MA) Tectonics (ISSN 0278-7407), vol. 7, June 1988, p. 663-684. refs
(Contract USGS-14-08-0001-G1151; NAG5-753)

The geometry of Turkish strike-slip faults is reviewed, showing that fault geometry plays an important role in controlling the location of large earthquake rupture segments along the fault zones. It is found that large earthquake ruptures generally do not propagate past individual stepovers that are wider than 5 km or bends that have angles greater than about 30 degrees. It is suggested that certain geometric patterns are responsible for strain accumulation along portions of the fault zone. It is shown that fault geometry plays a role in the characteristics of earthquake behavior and that aftershocks and swarm activity are often associated with releasing areas. R.B.

A88-49427
THE PRINCIPLES AND APPROACHES OF THE INTEGRATED INTERPRETATION OF AERIAL/SPACE AND GEOLOGICAL/GEOPHYSICAL INFORMATION IN STUDIES OF BURIED PLATFORMS [PRINTSIPY I NAPRAVLENIE KOMPLEKSNOI INTERPRETATSII AEROKOSMICHESKOI I GEOLOGO-GEOFIZICHESKOI INFORMATSII PRI IZUCHENII ZAKRYTYKH PLATFORMENNYKH TERRITORII]
D. M. TROFIMOV, V. A. BOGOSLOVSKII, A. P. BORISIUK, E. B. IL'INA, E. N. KUZ'MINA (Moskovskii Gosudarstvennyi Universitet; Vsesoiuznyi Nauchno-Issledovatel'skii Geologorazvedochnyi Neftianoi Institut, Moscow, USSR) et al. Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), May-June 1988, p. 36-42. In Russian. refs

A88-49428
AERIAL AND SPACE MONITORING OF NATURAL ICE COVER GEOSYSTEMS [AEROKOSMICHESKII MONITORING PRIRODNYKH NALEDNYKH GEOSISTEM]
A. G. TOPCHIEV (Vsesoiuznyi Nauchno-Issledovatel'skii Tsentr AIUS-Agroresursy, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), May-June 1988, p. 50-57. In Russian. refs

The results of ten-year-long aerial and space observations of ice covers in the areas of eastern Pamir and southern Iakutiia are discussed with special attention given to the data acquisition

methodology. It was found that systematic migration of ice crusts is most intense in valleys whose direction coincides with the direction of the most recent disjunctions. In zones which contain intersections of river valleys laid along the tectonic fractures formed during the most recent disjunctions, the systematic migration of ice cover is minimal. These features are interpreted in the framework of the Romanovski et al. (1972) concept concerning the cyclicity of self-forming ice covers on the zones above different types of talik. I.S.

A88-52436*# Chevron Oil Field Research Co., La Habra, Calif.
GEOLOGICAL REMOTE SENSING IN AFRICA
FLOYD F. SABINS, JR. (Chevron Oil Field Research Co., LaHabra, CA), G. BRYAN BAILEY (USGS, Sioux Falls, SD), and MICHAEL J. ABRAMS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 181-183.

Programs using remote sensing to obtain geologic information in Africa are reviewed. Studies include the use of Landsat MSS data to evaluate petroleum resources in sedimentary rock terrains in Kenya and Sudan and the use of Landsat TM 30-m resolution data to search for mineral deposits in an ophiolite complex in Oman. Digitally enhanced multispectral SPOT data at a scale of 1:62,000 were used to map folds, faults, diapirs, bedding attitudes, and stratigraphic units in the Atlas Mountains in northern Algeria. In another study, SIR-A data over a vegetated and faulted area of Sierra Leone were compared with data collected by the Landsat MSS and TM systems. It was found that the lineaments on the SIR-A data were more easily detected. R.B.

A88-52437#
GOLD EXPLORATION BY REMOTE SENSING TECHNIQUES IN WADI EL ALLAQI AREA, EASTERN DESERT, EGYPT
E. M. EL SHAZLY, M. A. ABDEL HADY, and F. A. EL NASHARTY (Academy of Scientific Research and Technology, Remote Sensing Centre, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 185-195. refs

The application of remote sensing techniques to gold exploration in the Wadi El Allaqi region of the Nubian desert is examined. Aerial photography on a 1:20,000 scale have been used to delineate geologic-lithologic units, the structural lineaments, drainage, and geomorphology. The results were compared with Landsat-1 images on a 1:1,000,000 scale. It was found that air-photos on scales smaller than 1:10,000 coupled with intense field investigations are necessary for the delineation of small targets for gold exploration. R.B.

A88-52469#
PRINCIPAL COMPONENT ANALYSIS OF AIRBORNE GEOPHYSICAL DATA FOR LITHOLOGIC DISCRIMINATION USING AN IMAGE ANALYSIS SYSTEM
J. R. HARRIS, L. NEILY, T. PULTZ (F. G. Bercha and Associates, Ltd., Radarsat Project Office, Calgary, Canada), and V. R. SLANEY (Geological Survey of Canada, Radarsat Project Office, Ottawa) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 641-657. refs

The principal component transform is investigated as a technique for combining and displaying airborne gamma ray spectrometer and magnetic data. Three test sites are studied; 2 in the Appalachian Structural Province of Nova Scotia, Canada, and 1 in the Precambrian Shield in Northern Manitoba, Canada. Color composite imagery of the first three or four components are visually and statistically interpreted for lithologic information. The principal component transform was found to be an effective technique for integrating the geophysical data. Color composite imagery provided good color separation of lithologic units and in the case of the Nova Scotian test sites, offered additional lithologic information within individual intrusive granites. Author

A88-52481#
STRUCTURAL ANALYSIS OF THE OLKARIA AREA, KENYA, BASED ON DIGITAL ENHANCEMENT OF LANDSAT DATA
STEVEN A. M. EARLE (Saskatchewan Mining Development Corp., Saskatoon, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 805-812. refs

A88-52487#
GEOLOGICAL APPLICATION OF LANDSAT DATA IN MAPPING THE DISTRIBUTION OF LATE TERTIARY AND QUATERNARY SEDIMENTS IN THE KENYA RIFT VALLEY
BENSON MBOYA (Nairobi, University, Kenya) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 899-906. refs

A88-52489#
MONITORING OF OPEN-CAST COAL MINING AND RECLAMATION WORKS IN THE UNITED KINGDOM USING MSS AND TM IMAGERY
CHRISTOPHER A. LEGG (National Remote Sensing Centre, Farnborough, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 931-941. refs

A88-52532#
LITHO STRUCTURAL CONTROL OVER ANOMALOUS RADIOACTIVE ZONES IN NORTH KERALA - A CASE STUDY BASED ON RADIOMETRIC AND LANDSAT MSS DATA
JOHN MATHAI, VENKATESH RAGHAVAN, and G. K. RAJU (Centre for Earth Science Studies, Trivandrum, India) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1371-1377. refs

A88-52534#
EVALUATION AND EXPLOITATION OF NATURAL RESOURCES BASED UPON A RADAR SURVEY IN GABON
J. GILLI and S. BAELZ-MANIERE (Societe d'Etude Techniques et d'Entreprises Generales, Valbonne, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1387-1391.

A88-52544#
GEOMORPHOLOGICAL MAP OF QATAR PENINSULA
MAHMOUD M. ASHOUR (University of Qatar, Doha) and NABIL S. EMBABI (Ain Shams University, Cairo, Egypt) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1481-1494. refs

A geomorphological map of the Qatar Peninsula at 1:250,000 scale was prepared using Landsat images at 1:250,000 scale, corroborated with aerial photographs at 1:16,000 scale, topographic maps, geologic maps and field surveys. The geomorphological features were classified into coastal, aeolian, fluvial, and karstic features and sabkhas (inland and coastal flats). The features which fall into each of these classifications are outlined. The images used in producing the map and the final map are presented. R.B.

A88-52858
OUTGOING INFRARED RADIATION OF THE EARTH AS AN INDICATOR OF SEISMIC ACTIVITY [UKHODIASHCHEE INFRAKRASNOE IZLUCHENIE ZEMLI - INDIKATOR SEISMICHESKOI AKTIVNOSTI]
V. I. GORNYI, A. G. SAL'MAN, A. A. TRONIN, and B. V. SHILIN (AN SSSR, Institut Fiziki Zemli, Moscow; Vsesoiuznyi Nauchno-Issledovatel'skii Institut Kosmo-Aerometodov, Leningrad, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 301, no. 1, 1988, p. 67-69. In Russian. refs

An analysis of remote-sensing images of the earth's surface in the 10.5-11.3-micron range has shown a stable increase of outgoing IR radiation over linear structures of a seismically active region in Central Asia as compared with adjacent areas. A number of earthquakes in this region in 1984 were found to be connected with anomalous increases of outgoing IR radiation. These data indicate that outgoing IR radiation can be used as an indicator of seismic activity. B.J.

N88-26714# Battelle Columbus Labs., Ohio.
REMOTE SENSING AND SATELLITE APPLICATIONS TO THE NEEDS OF THE GAS AND PIPELINE INDUSTRY
A. G. MOURAD and T. J. KUZMA Oct. 1987 138 p
(Contract GRI-5087-271-1520)
(PB88-202668; GRI-87/0346) Avail: NTIS HC A07/MF A01
CSCL 08B

A survey of gas industry needs was made along with a literature search involving remote sensing techniques with possible applications to gas industry needs. A questionnaire was developed covering the areas of leak detection, right of way monitoring, pipeline location, pipeline conditions, exploration, and communications. The questionnaire was used to interview personnel from the gas industry, the Gas Research Institute, and consulting firms. The results from these inteviews indicate the most active areas of concern are monitoring the right of way, detecting leaks and pipeline conditions, and upgrading communication systems. The literature search indicated that many aspects of remote sensing and satellite technology could be applicable to the gas industry's needs. An overview of remote sensing was prepared, and specific techniques were outlined that could be utilized by the gas and pipeline industry. Some qualitive analyses of the remote sensing and satellite applications to the industry's needs were performed. Author

N88-28365 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
SPOT FOR EARTHQUAKE HAZARD ZONING IN SOUTHERN ITALY
R. J. ELSINGA and H. TH. VERSTAPPEN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 199-207 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The geology and geomorphology of the (1980) earthquake area in southern Italy was studied using SPOT stereo images (1:100,000 and 1:200,000) to develop a method of earthquake hazard zoning also applicable to other areas of similar terrain configuration and structure. The images prove very useful in outlining terrain units and deciphering complex geologic structures, particularly because of the stereoscopic capacity. Lithology, dip direction, slope angle, and lineaments are major elements governing the distributional pattern of earthquake hazards that, in the area, comprise mainly mass movements, vibration, and soft ground conditions. A major advantage of SPOT images is the much better detection of lineaments, particularly in comparatively nonresistant rocks, where landsliding is most common. Extrapolation of the method to the Upper-Agri basin, situated farther to the southeast, proves feasible. ESA

N88-28401 South Australian Centre for Remote Sensing.
UTILIZING SPOT DATA FOR SEISMIC SHOT-LINE MAPPING AND ENVIRONMENTAL MONITORING IN OIL AND GAS EXPLORATION
JOHN S. DOUGLAS and BILL HEDDISH (Delhi Petroleum Co., Australia) *In* CNES, Spot 1 Image Utilization, Assessment, Results p 531-540 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Multispectral and panchromatic SPOT data were evaluated for their ability to detect and map seismic shot-lines in the Cooper Basin oil and gas field of South Australia. The data were also compared with LANDSAT data for the production of vegetation and habitat sensitivity maps. Field work, both ground and aerial was used to verify the results. It is shown that proposed shot-line and access road programs can be tested and modified to achieve the least-impact and lowest cost option. It is estimated that operationally this technique can reduce the environmental impact to a minimum by selective placement of shot-lines and access roads. Concomitantly it can reduce the number and length of shot-lines. The SPOT data will serve as an increasingly valuable tool in oil and gas exploration in desert and other environments. ESA

N88-28419 Desert Research Inst., Reno, Nev.
FIRST RESULTS OF INTERNATIONAL INVESTIGATIONS OF THE APPLICATIONS OF SPOT-1 DATA TO GEOLOGIC PROBLEMS, MINERAL AND ENERGY EXPLORATION
JAMES V. TARANIK *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 701-708 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT and LANDSAT in geosciences was compared. The SPOT data are more useful than MSS. In analyzing topography to interpret landforms and drainage patterns 10m resolution SPOT stereoscopic data is superior to TM data for analysis at 1:50,000 scale. However, the higher solar illumination angle created by SPOT-1 data acquisition 1 hr later than LANDSAT, coupled with data mostly acquired in summer months, creates problems, as does using stereoscopic data pairs acquired under different cover conditions. It is preferred to work with one SPOT nadir view and one oblique view when analyzing SPOT data in stereoscopic mode. Synoptic stereoscopic coverage provided by SPOT-1 has a distinct advantage over mosaics of larger-scale and higher resolution aerial photography, although such photography is desirable for detailed geologic studies. The additional spectral resolution provided by TM is most important for mineral exploration investigations and investigations involving detailed geologic mapping. Investigators report registering spatially filtered SPOT-1 panchromatic data to LANDSAT TM data to take advantage of spatial and spectral resolution provided by each system. The SPOT-1 computer compatible tape data was analyzed successfully using ratioing techniques and found to display variations in iron oxide abundance on rocks and soils. ESA

N88-28420 Institut de Physique du Globe, Paris (France).
RATE OF SLIP ON THE ALTIN DAGH FAULT (NORTH TIBET, CHINA)
G. PELTZER, R. ARMIJO, and P. TAPPONNIER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 709-718 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Holocene morphological structures in highly elevated regions of Asia were investigated as markers for recent deformations in that continent. The high resolution of SPOT images was used to analyze such markers and to measure the offsets produced by active faults. The study of several sites distributed along the Altin Dagh fault (North Tibet) leads to a direct estimation of 2 to 3 cm/yr of left-lateral slip on this fault. ESA

N88-28422 Amoco Production Co., Houston, Tex.
RESULTS OF THE GEOSAT PROGRAM TO EVALUATE SPOT DATA FOR PETROLEUM AND MINERAL EXPLORATION
R. N. BAKER, F. B. HENDERSON, III (Geosat Committee, Inc., Norman, Okla.), M. SETTLE, J. MCKEON, C. SHEEHAN, S.

GUTMAN, S. PERRY, J. TARANIK, M. BORENGASSER, A. PRELAT et al. *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 731-738 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Digital and image data from SPOT were analyzed to determine their application to petroleum and mineral exploration. Three test sites were selected, each with adequate ground truth to provide meaningful comparisons with LANDSAT, color IR (NHAP) aerial photographs, Seasat SAR, and LANDSAT MSS and TM data. Results show that SPOT stereo XS data are superior to LANDSAT MSS and TM for regional structural analyses, while TM data provide greater spectral range and resolution for lithologic and microseepage (tonal discrimination) studies. The SPOT panchromatic data merged with selected TM bands provide the optimum, cost effective product for most geological applications.
ESA

N88-28423 Nevada Univ., Reno. Cooperative Inst. for Aerospace Science and Terrestrial Applications.
THE APPLICATION OF SPOT DATA TO THE STRUCTURAL GEOLOGY OF WESTERN NEVADA
MARCUS X. BORENGASSER and JAMES V. TARANIK *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 739-741 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Panchromatic and multispectral data SPOT including nadir and off-nadir format, were analyzed for an area within the Walker Lane of western Nevada. Data were registered to a UTM projection, subscenes were selected and enhanced, and stereo pairs were produced. This procedure facilitated the identification and location of structural features associated with Walker Lane. The SPOT panchromatic stereo data are well-suited for structural analysis of western Nevada.
ESA

N88-28424 Paris VI Univ. (France). TELEGEOL.
APPLICATION SPOT-1 DATA TO MINING ACTIVITY: EXAMPLE OF THE IMITER SILVER MINE, MOROCCO
B. CERVELLE, J. CHOROWICZ, J. P. RUDANT, G. TAMAIN, E. M. ALEM, and M. BEKKALI (Institut Scientifique de Rabat, Morocco) *In* CNES, SPOT 1 Image Utilization Assessment, Results p 743-748 1988 In FRENCH; ENGLISH summary Original contains color illustrations
(Contract CNES-86-1263)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT concerning the district (20x20 km) of the Imiter silver mine (Anti-Atlas, Morocco) were processed, and compared with spectrometric terrain measurement. Thanks to the high spatial resolution and to the stereoscopic capability, the teleanalytical map which was drawn displays radiometrical, morphological, and structural features of great utility to plan the extension of the mining activities.
ESA

N88-28425 Institut Francais du Petrole, Rueil-Malmaison.
EVALUATION OF SPOT IMAGERY CONTRIBUTION TO PETROLEUM EXPLORATION: THE SUEZ RIFT (EGYPT)
B. COLLETTA, M. BECUE (BEICIP, Rueil-Malmaison, France), C. LALLEMAND, G. LEGENDRE, and F. BENARD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 749-754 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Analysis of a SPOT image with conventional methods of photointerpretation and digital processing was used to identify most of the lithostratigraphic units of the Suez Rift (Egypt). The stereoscopic view gives a detailed structural sketch which is in good agreement with surface and subsurface geological data. Owing to high resolution and the stereoscopic view, SPOT imagery in the Suez Rift area produces reliable mapping. Thus it constitutes a useful tool for an early exploratory program in desert areas.
ESA

N88-28426 London Univ. (England). Royal Holloway and Bedford New College.
EVALUATION OF SPOT IMAGERY FOR DISCRIMINATING VEGETATION COMMUNITIES ASSOCIATED WITH SURFICIAL AND BEDBROCK GEOLOGY AND IDENTIFYING ANOMALOUS AND STRESSED VEGETATION ASSOCIATED WITH MINERALIZATION
M. M. COLE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 755-763 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Imagery from SPOT covering the areas containing the Ngwenalekau copper deposit in Western Botswana, the Dugald river lead-zinc deposit in northwest Queensland, and the Thalanga copperlead-zinc deposit in eastern Queensland, Australia, was evaluated with reference to field and laboratory data and by comparison with LANDSAT MSS data and aerial photography. Evaluation is based on information obtained from enhanced color composites generated from the three spectral bands, band ratios, and principal components analysis. The results obtained differ for the three areas, a consequence of differing environments, and the differing characteristics of the anomalous and stressed vegetation in each. On enhanced color composites generated from the three SPOT HRV bands, discrete vegetation associations that discriminate surficial and bedrock geology are readily distinguished in each study area. The geobotanical anomalies over the copper deposit and the lead zinc lode are discriminated and that over the concealed extension of the ore horizon can be detected. The Thalanga gossan is uniquely displayed. Color composites of principal components and of band ratios effectively discriminate the vegetation anomalies and the Thalang gossan while band ratios identify the concealed extension of the Thalanga ore horizon.
ESA

N88-28427 Open Univ., Milton (England). Dept. of Earth Sciences.
SPOT IMAGERY AS AN AID TO UNDERSTANDING VOLCANISM AND TECTONICS: EXAMPLES FROM THE CHILEAN ANDES AND THE TIBETAN PLATEAU
DAVID A. ROTHERY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 765-772 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT for preliminary mapping of geological and general terrain features, and detailed lithological discrimination was assessed for two areas: Socompa volcano and debris avalanche deposit (N Chile) and the Dungbure lava field (NE Tibetan plateau). The XS stereoscopic data for the Socompa debris avalanche deposit (N Chile) are no great advance on existing data. This area received considerable attention in the field and using other remote sensing systems. Spectrally, the SPOT system is inferior to LANDSAT TM for lithological discrimination, and in this case the textural details on the SPOT images are less useful than those shown up by MOMS-01 under evening illumination. However, SPOT images of this area provide an informative, synoptic stereoscopic view of the deposit, which helps the interpreter appreciate the processes of emplacement of this deposit, in a way which cannot be easily achieved using air photographs or the 1:50,000 contour map. An XS stereo-pair of the Dungbure lava flow which is a remote and virtually unknown area previously imaged only by LANDSAT MSS, provides much more information. The lava field was clearly uplifted along its NNW edge; faults interpreted on MSS imagery have no topographic expression and are reinterpreted as wind streaks; and a rift coming from the main vent on the lava field is shown up as a normal fault with a throw in excess of 20 m. The lava field shows no evidence of original perceptible slope away from its major vent. A few flow margins can be defined within the main lava field. There are no spectral indications of oxidation or other alteration around lava sources.
ESA

N88-28428 Bureau de Recherches Geologiques et Minieres, Orleans (France).
ROLE OF SPOT IN GEOLOGICAL APPLICATION OF REMOTE SENSING [ROLE DE SPOT DANS LE DEVELOPPEMENT DES APPLICATIONS GEOLOGIQUES DE LA TELEDETECTION]
J. M. BROSSE, S. CHEVREL, PH. DUTARTRE, F. GIRAULT, J. F. MALON, and J. Y. SCANVIC *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 773-785 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It is shown that remote sensing developments in geological mapping, ore exploration, industrial rocks, and underground water prospection, limited by spatial and spectral resolutions can advance with the second generation of Earth resources satellites. This is demonstrated with studies realized with SPOT data, under different climatic conditions, in Guinea, Botswana, Saudia Arabia, and France. ESA

N88-28429 Service Teledetection et Sciences de l'Image, Marseille (France).
SPOT IMAGERY PRELIMINARY CONTRIBUTION TO CARTOGRAPHY AND GEODYNAMICS IN THE BENUE TROUGH (NIGERIA)
B. SIMON and M. POPOFF (Centre Scientifique de Saint-Jerome, Marseille, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 787-795 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The utility of SPOT, multispectral images in analyzing the mechanisms of individualization of the Benue trough (Nigeria) over the geological timescale is shown. The SPOT multispectral images provide useful information on structures such as folds and layers, which become easily identifiable. Lineaments are clearer, allowing small structures to be detected, although large lineaments are more visible on LANDSAT images. Classification tests show that it is possible to obtain a clear, useful subdivision from a limited number of polygons for areas poorly mapped. ESA

N88-28430 National Physical Research Lab., Pretoria (South Africa).
AN EVALUATION OF SPOT IMAGERY FOR EARTH SCIENCE STUDIES IN THE ANTARCTIC. PRELIMINARY EVALUATION PROGRAM (PEPS) 289 FOR SPOT
O. G. MALAN and A. D. LAMB *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 797-801 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The utility of oblique panchromatic SPOT imagery of the Borga mountains of Antarctica was evaluated for Earth science studies and logistics. Problems associated with data acquisition and data quality are discussed. The most useful products are 1:50,000 scale hard copies, linearly stretched to give detail in dark or light areas. Stereo capabilities are limited because of imaging constraints and saturation. The imagery could prove to be invaluable in areas with no aerial photography for planning approach and supply routes. The imagery proves to be of limited value in the geology of the study area, other than as a convenient base map. The cost of SPOT imagery should be a minor consideration, considering potential savings which could be effected in the very costly logistic support and the cost of aerial photography in this environment. ESA

N88-28431 Exxon Production Research Company, Houston, Tex.
STRUCTURAL ANALYSIS OF THE JURA MOUNTAINS-RHINE GRABEN INTERSECTION (SWITZERLAND) FOR PETROLEUM EXPLORATION USING SPOT STEREOSCOPIC DATA
H. R. HOPKINS, H. NAVAIL (Esso REP, Begles, France), Z. BERGER, B. F. MEREMBECK, R. L. BROVEY, and J. S. SCHRIVER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 803-810 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Multispectral (XS) and panchromatic (PA) SPOT stereoscopic digital data were examined over a structurally complex, vegetated test site in the Jura Mountains of Switzerland, and additional test sites were examined in the western United states where low to moderate-dipping geologic formations are exposed. The SPOT data were used with geological, geophysical, LANDSAT Multispectral Scanner (MSS), and Thematic Mapper (TM) data to simulate a full-scale petroleum exploration study. Increased spatial resolution, especially of the 10 m PA data, allows analysis of key structures and stratigraphic elements not visible on other satellite data. Stereoscopic capabilities of XS or PA images can be used to derive qualitative or quantitative strike-and-dip information essential for accurate structural mapping. All remote-sensing data sets are useful in petroleum exploration when considering resolution, availability, and cost. The PA data are excellent for providing high spatial-resolution detail and stereoscopic viewing for topographic and structural mapping not available from other satellite data sets; XS data provide similar information at lower resolution. Merged PA and XS, or PA and TM data, yield easily interpretable images with good color separation from the multispectral data and high spatial resolution from the panchromatic data. Low-resolution MSS data are useful and cost effective for large regional studies, while the 30 m spatial resolution and 7 spectral bands of TM data make it the best for lithologic mapping. ESA

N88-28432 Institut Francais du Petrole, Rueil-Malmaison.
METHODOLOGY FOR THE USE OF SPOT IMAGERY IN PETROLEUM EXPLORATION. EXAMPLE OF THE BAS-LANGUEDOC AREA (FRANCE)
GEORGES GESS, JEAN CHOROWICZ, BERNARD BECUE, ROBERT CURNELLE, JEAN-PAUL DEROIN, JACQUES HUGER, GILBERT PERRIN, and DANIEL RONFOLA (ELF-ERAP, Paris, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 811-824 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It is shown that due to improved ground resolution, stereoscopy, and image processing, SPOT images allow geological analyses, including updated regional geological mapping, to be done quickly. These data are used for reconsideration of the structural framework of an area subject to petroleum exploration. The methodology is a compilation of all existing geological knowledge about the area and of precise space data that bring new observations, and are very useful for structural synthesis. Geological interpretations of a fault zone, including extensive and compressive relays, and the odd shaped folds regarded as due to basin reversal, are compared with seismic reflection profiles. ESA

N88-28433 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
ANALYZING THE STRATIGRAPHY, TECTONISM, AND MINERALIZATION AT THE SPANISH SIDE OF THE PYRITE BELT, HUELVA PROVINCE, SPAIN, USING SPOT IMAGERY
TSEHAIE WOLDAI *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 825-836 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Images in P and XS mode from SPOT, covering 60 km by 60 km were used to study the lithostratigraphy and tectonics of mineralogically important zones of the Spanish pyrite belt. The SPOT images clearly show the different units of the region. Advantages over other remote sensing data using SPOT are observed: SPOT synoptic stereo viewing increases the confidence level of interpretability and in geological interpretation, this is an advantage over all other satellite remote sensing. Continuity of structures are easily traced. Lithological boundaries whose overall pattern can be reflective of structure can be accurately followed over a wide area. Fold noses are not clear in SPOT or TM and

seem always cut by fault structures in the area. However, major folds can be indirectly identified by the symmetrical distribution of rock units. ESA

N88-28434 Smithsonian Institution, Washington, D. C. Center for Earth and Planetary Studies.
GEOLOGIC APPLICATIONS OF SPOT-1, TM, AND NOAA-7 DATA: FINDING AND DEFINING UNMAPPED STRUCTURAL FEATURES
CONSTANCE G. ANDRE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 837-844 1988 Original contains color illustrations
(Contract NAGW-958)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Stereoscopic SPOT data are used to analyze the structural detail along a 100 km long lineament first seen in low-resolution NOAA-7 thermal infrared data. The SPOT-1 and TM images of central Saudi Arabia support interpretations of NOAA-7 thermal-infrared data indicating that the Najd fault zone was reactivated during the initial stages of Red Sea rifting. The SPOT, TM, and NOAA-7 data indicate a shear zone resulting from reactivation of basement faults since the Paleozoic. The predominant lineament trend is consistent with that of faults in the Najd Zone and faults to the SE beyond the Empty Quarter in South Yemen. The age of the strata affected indicate that reactivation of basement faults under the cover rocks and formation of the Red Sea may have been simultaneous. If the inferred eastern extension of the Najd zone into the cover rocks is extrapolated beneath sands of the Empty Quarter, a zone of NW-trending fractures 2000 km long would span the Arabian Peninsula, connecting opposite plate boundaries. It would be one of the major continental fault systems on Earth. ESA

N88-28436 Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRAL AND SPATIAL ATTRIBUTE EVALUATION OF SPOT DATA IN GEOLOGICAL MAPPING OF PRECAMBRIAN TERRAINS IN SEMIARID ENVIRONMENT OF BRAZIL
W. R. PARADELLA, I. VITORELLO, C. C. LIU, J. T. MATTOS, P. R. MENESES, and L. V. DUTRA *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 851-860 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Utilization of SPOT for geological mapping was assessed. Results for a site with complex precambrian geology, geomorphology, vegetation and soil cover, atmospheric components, acquisition dates, and viewing-illumination geometry show that lithological discrimination is optimized when the data analysis is associated to the SPOT panchromatic stereo vision and to the TM spectral resolution. The possible radiometric degradation related to the westward oblique SPOT viewing does not seriously prevent the extraction of lithological information even though the images presents less radiometric contrast mainly in the shorter wavelength bands, when compared to the analysis of similarly positioned TM bands. In regional mapping neither SPOT or LANDSAT TM add significant geological information to the map derived from LANDSAT MSS images. ESA

N88-28437 Paris VI Univ. (France). Dept. de Geotectonique.
GEOLOGIC RESULTS OBTAINED FROM THE USE OF SPOT IMAGERY ALONG PLATE BOUNDARIES: EXAMPLES IN THE EAST AFRICAN RIFT AND OF THE NORTHERN-CARIBBEAN COLLISION
J. CHOROWICZ, M. BOISSEAU, B. MERCIERDELEPINAY, J. P. RUDANT, and G. VIDAL *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 861-869 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Stereoscopic SPOT imagery was used to update fault pattern and lithostratigraphic sequence maps along plate boundaries. In Kenya, the map is deeply changed, including the lithostratigraphic sequence, and gives a better view of the tilted blocks in an area where two fault directions cross at high angle. In Hispanola, Late Miocene to Recent N.80 to 90 deg striking faults are revealed. They cut the ophiolotic suture and display a left-lateral horizontal throw of 5 km. Mapping in the field was not able to provide a complete view of this fracturing. ESA

N88-28439 Musee Royal de l'Afrique Centrale, Tervuren (Belgium).
ANALYSIS OF THE MULTISPECTRAL CONTENT AND OF SPOT SUBSCENES IN TWO REGIONS OF BURUNDI. LITHOLOGIC AND TECTONIC INTERPRETATIONS
K. THEUNISSEN, PH. TREFOIS, and J. LAVREAU *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 881-886 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In the region of Ngozi (N Burundi), a subscene displaying a variety of granitoids intruding a Middle Proterozoic sedimentary series was selected to evaluate the possibilities of SPOT for lithologic discrimination. Multiband manipulations were applied, including false color compositions, ratioing, principal component analysis, and IHS transform and masking. Known lithologic units are recognized with varying success; most striking however is the determination of the extent of a syenite intrusion. In the Nkoma massif (SE Burundi), enlargements to 1:100,000 of a stereoscopic pair were used for a structural study of the Upper Proterozoic Nkoma unit. A well expressed joint pattern, prominent lineaments, characteristic morphologic features point to a multi-episodic deformation mechanism for this unit. Studies based on air-photos (scale 3:30,000 to 1:50,000), mosaics as well as on satellite products do not allow such a detailed analysis. ESA

N88-28442 Paris VI Univ. (France). Dept. de Geotectonique.
DETAILED GEOLOGICAL MAPPING OF THE MASSIF OF SAINTE VICTOIRE (PROVENCE, FRANCE) USING SPOT IMAGERY. COMPARISON WITH OTHER MULTISOURCE DATA. NEW TECTONIC INTERPRETATION OF THIS REGION
JEAN CHOROWICZ, ALI MEKARNIA, and JEAN PAUL RUDANT *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 905-913 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The SPOT capabilities in geological mapping at a 1:50,000 scale were assessed in a geologically complex and very well known area (Provence, France). Results of teleanalysis were compared with maps drawn from LANDSAT MSS and TM imagery, as well as with the existing 1:50,000 geologic map. Mapping of fracturing and of the lithologic units is greatly improved. Precise mapping of the lithologic traces (using stereoscopy and 10 m ground resolution) gives an advanced geologic map. The results establish a tectogenetic model for this area, dealing with normal synsedimentary faults acting during Mesozoic times, giving a ramp pattern, reactivated by the Provencal compression (Late Eocene). ESA

N88-28460 Ifremer, Paris (France).
APPLICATION OF SPOT IMAGERY FOR OIL SPILL CONTINGENCY PLANNING
JACQUES DENIS, ALAIN GROTTE, JACQUES POPULUS, and ERIC DUTRIEUX (Total CFP, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1069-1078 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Space imagery was used for impact studies of oil spill contingency plans. By photointerpretation and processing of SPOT data, a thematic map of a large and complex area such as the Mahacam Delta (Borneo) can be realized. The knowledge of environment sensitivity helps to define the strategic actions to be adopted for spill control. ESA

N88-28463 Committee for Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Aeras, Suva (Fiji).
EVALUATION OF THE CONTRIBUTION OF SPOT IN THE FRAMEWORK OF THE MINERAL EXPLORATION PROGRAM OF THE AITUTAKI ATOLL (COOK ISLANDS). PRELIMINARY STUDY OF THE IMPACT OF THE PASSAGE OF HURRICANE SALLY [EVALUATION DE L'APPORT DE SPOT DANS LE CADRE DU PROGRAMME DE PROSPECTION DES RESSOURCES MINERALES DE L'ATOLL D'AITUTAKI (ILES COOK). ETUDE PRELIMINAIRE DE L'IMPACT DU PASSAGE DU CYCLONE SALLY]
O. LEMAIRE, L. LAUBERSAC (Institut Francais de Recherche pour l'Exploitation de la Mer, Brest, France), L. DOZOUVILLE, and D. RICHMOND *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1095-1103 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The digital processing of the SPOT image obtained over the Aitutaki Atoll (June 23, 1986) was developed such as to propose a transformation of basic data, delivering better information for shallow water bodies. Two derived models for bathymetry and bed mapping are introduced. Comparison between this reference image and those obtained after the Sally cyclone damaged the atoll reveals the SPOT data interest in storm damage assessment studies. ESA

N88-28474 Digim (1983), Inc. Montreal (Quebec).
DIGITAL TERRAIN MODELLING WITH SPOT DATA AND GEOLOGICAL APPLICATIONS
R. SIMARD, TH. TOUTIN, A. LECLERC, S. R. HAJA, M. ALLAM, R. BOURDEAU, and R. SLANEY (Energy, Mines and Resources Canada, Ottawa, Ontario) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1205-1212 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT-1 HRV were analyzed to produce digital elevation models (DEMs) using automatic stereocompilation techniques. Tests were performed at several different sites using different combinations of ground data and image-acquisition geometry in order to establish the validity of the proposed methodology in processing SPOT data. Geological and gravimetric applications of DEM were investigated, showing that SPOT data may also be utilized in these fields. ESA

N88-29663*# Sheffield Univ. (England). Dept. of Geology.
MAPPING OF VOLCANIC UNITS AT ALBA PATERA, MARS
PETER CATTERMOLE *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars p 37-39 1987
Avail: NTIS HC A07/MF A01 CSCL 03B

Detailed photogeologic mapping of Alba Patera, Northern Tharsis, was completed and a geologic map prepared. This was supplemented by a series of detailed volcanic flow maps and used to study the morphometry of different flow types and analyze the way in which the behavior of the volcano has changed with time and also the manner in which flow fields developed in different sectors of the structure. Author

N88-29676*# London Univ. Observatory (England).
LAVA FLOW-FIELD MORPHOLOGY: A CASE STUDY FROM MOUNT ETNA, SICILY
J. E. GUEST, J. W. HUGHES, and A. M. DUNCAN (Luton Coll. of Higher Education, England) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars p 69-71 1987
Avail: NTIS HC A07/MF A01 CSCL 03B

The morphology of lava flows is often taken as an indicator of the broad chemical composition of the lava, especially when interpreting extraterrestrial volcanoes using spacecraft images. The historical lavas of the active volcano Mount Etna in Sicily provide an excellent opportunity to examine the controls on flow field morphology. In this study only flow produced by flank eruptions after the middle of the 18th century are examined. The final form of a flow-field may be more indicative of the internal plumbing of the volcano, which may control such factors as the effusion, rate, duration of eruption, volume of available magma, rate of de-gassing, and lava rheology. Different flow morphologies on Etna appear to be a good indicator of differing conditions within the volcanic pile. Thus the spatial distribution of different flow types on an extraterrestrial volcano may provide useful information about the plumbing conditions of that volcano, rather than necessarily providing information on the composition of materials erupted. Author

N88-30168# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF LANDSAT-TM DATA FOR GEOMORPHOLOGICAL MAPPING
TERESA GALLOTTIFLORENZANO and HERMANN JOHANN HEINR KUX Jun. 1988 9 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication (INPE-4593-PRE/1324) Avail: NTIS HC A02/MF A01

The objective of this study is to evaluate LANDSAT/TM data to perform geomorphological mapping in a semiarid environment. The tests site is located at the Rio Parnaiba Valley (Piaui and Maranhao states), NE, Brazil. Data sets of TM (bands 3, 4, 5, and 7) were digitally analyzed using the following algorithms: linear contrast stretch, principal components and IHS transformations. Different color composites were obtained. Finally a discussion is made on the usefulness of digital processing techniques using TM data to discriminate geomorphological units. Author

N88-30173# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
USE OF DIGITAL IMAGES AS A MINERAL PROSPECTING TOOL IN THE TIN PROVINCE OF GOIAS, BRAZIL
RAIMUNDO ALMEIDAFILHO May 1988 12 p Presented at the 16th Congress for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication (INPE-4537-PRE/1284) Avail: NTIS HC A03/MF A01

The application of LANDSAT-TM images is discussed as an auxiliary tool for mineral prospecting in the tin province of Goias, Central Brazil. Six granitoid massifs were studied through multispectral/multiseasonal analysis of digitally enhanced images. The presence of locally specific geobotanical association has permitted the discrimination of albitized/greisenized facies of these granitoids. These metasomatically altered facies are important as lithological control of significant tin (cassiterite) mineralization in the region. Field check has indicated the occurrence of cassiterite in most of the target areas identified by the study. This fact has allowed production of accurate maps which show potential mineralized areas for each granitoid. Prospection for primary tin deposits in the region should be directed to specific target areas, which represent less than 5 percent of the total surface of the granitoids, resulting in substantial savings in time and cost. Author

N88-30223*# Mainz Univ. (West Germany).
GROWTH OF EARLY ARCHAEAN CRUST IN THE ANCIENT GNEISS COMPLEX OF SWAZILAND AND ADJACENT BARBERTON GREENSTONE BELT, SOUTHERN AFRICA
A. KROENER, W. COMPSTON, A. TEGTMEYER, C. MILISENDA, and T. C. LIEW (Max-Planck-Inst. fuer Chemie, Mainz, West Germany) *In* Lunar and Planetary Inst., Workshop on the Growth of Continental Crust p 85-87 1988
Avail: NTIS HC A08/MF A01 CSCL 08G

The relationship between early Archean greenstones and high grade gneisses in the Ancient Gneiss Complex of Swaziland and the neighboring Barberton greenstone belt in Southern Africa is discussed. New high precision zircon analyses reveal a complex history in individual zircons from tonalitic orthogneisses, with ages as old as 3644 + 4 Ma. This suggests the presence of continental crust prior to the formation of the supracrustal rocks of the

Barberton greenstone belt, which have been previously considered the earliest rocks in the area. The author suggested that these data are incompatible with the intraoceanic settings that have been widely accepted for this terrane, and favors either a marginal basin or rift environment. By using the detailed age information obtained from zircons in combination with Ar-40 and Ar-39 and paleomagnetic measurements, the author estimated that plate velocities for this part of Africa craton were about 10 to 70 mm/yr, during the period 3.4 to 2.5 Ga. This is not incompatible with the idea that Archean plate velocities may have been similiar to those of today. E.R.

N88-30228*# Massachusetts Univ., Amherst. Dept. of Geology and Geography.
STRUCTURE OF SOUTHWESTERN MICHIPICOTEN GREENSTONE BELT, ONTARIO: EVIDENCE FOR ARCHEAN ACCRETION
GEORGE E. MCGILL and CATHERINE H. SHRADY *In* Lunar and Planetary Inst., Workshop on the Growth of Continental Crust p 98-100 1988
Avail: NTIS HC A08/MF A01 CSCL 08G

The results of detailed mapping of a well exposed (by a large fume kill) Archean Michipicoten greenstone belt of Ontario is discussed. Numerous structural features are described including soft sediment deformation, thrust faults, isoclinal folds, and sill intrusion, which apparently formed prior to the earliest flattening cleavage. It was inferred that all of these events may have taken place before the rocks were completely lithified, and the question was raised as to whether early soft sediment and tectonic deformation were coeval. If so, the overall picture would permit (but not compel) recognition of a convergent oceanic environment such as an accretionary wedge or forearc basin. E.R.

N88-30255*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
VOLCANIC CONTRIBUTION TO CRUSTAL GROWTH IN THE CENTRAL ANDES: A NEW ESTIMATE AND A DISCUSSION OF UNCERTAINTIES
C. A. WOOD and P. FRANCIS (Lunar and Planetary Inst., Houston, Tex.) *In* Lunar and Planetary Inst., Workshop on the Growth of Continental Crust p 169-171 1988
Avail: NTIS HC A08/MF A01 CSCL 08G

Volcanism above subduction zones is a major mechanism for crustal growth and compared to some other proposed processes calculation of growth rates is relatively easy given accurate volumes and ages of volcanic material. Francis and Rundie (1976) first used this approach in a small region of the Central Andes, and extrapolated their result to the entire Central Andean arc. The derived rate of 3 to 4.2 x 10 to the minus 6th cubic km yr/km of arc length is compared with an independent estimate based upon a reconnaissance census of all major volcanoes in the Central Andes. Author

N88-30529# Joint Publications Research Service, Arlington, Va.
OBLIGUE METALLOGENIC ZONES RECOGNIZED BY INTERPRETING SPACE PHOTOGRAPHS OF SOUTHERN TIEN SHAN Abstract Only
N. T. KOCHNEVA, G. A. TANANAYEVA, and R. A. BELOV *In its* JPRS Report: Science and Technology. USSR: Space p 23-24 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1987 p 41-46 Original language document was announced in IAA as A88-19565
Avail: NTIS HC A04/MF A01

A new type of poorly discernible oblique metallogenic zone has been identified on satellite remote-sensing imagery. The typical features of these zones are described for different landscapes in the southern Tien-Shan territory. It is found that the oblique zones affect the location of mineral ore deposits. Author

N88-30530# Joint Publications Research Service, Arlington, Va.
STRUCTURE OF EASTERN TURKESTAN RIDGE BASED ON SPACE PHOTOGRAPHS Abstract Only
I. G. TSUKORNIK, A. V. ALEKSEYENKO, A. V. BEREZANSKIY, and I. I. SOLOSHENKO *In its* JPRS Report: Science and Technology. USSR: Space p 24 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1987 p 47-52 Original language document was announced in IAA as A88-19566
Avail: NTIS HC A04/MF A01

Lineaments identified on space photos of the eastern Turkestan Range are considered. The observed lineament zones correspond to latitudinally oriented Paleozoic structural-formational zones in the region. Submeridional zones indicating hidden deep-seated faults with an anti-Tien Shen direction are also identified. Author

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OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

A88-46360
MAPPING A RED SEA COASTAL AREA BY DIGITAL PROCESSING OF SPOT 1 HRV DATA [CARTOGRAPHIE D'UNE ZONE LITTORALE EN MER ROUGE PAR TRAITEMENTS NUMERIQUES DES DONNEES HRV DE SPOT 1]
J. COURBOULES, R. MANIERE (Nice, Universite, France), J. JAUBERT (Nice, Universite; Mission Oceanographique Francaise au Moyen-Orient, Nice, France), A. S. MANDURA, A. K. KHAFFAJI (King Abdulaziz University, Jeddah, Saudi Arabia) et al. Photo Interpretation (ISSN 0031-8523), vol. 26, July-Aug. 1987, p. 35-39, 41, 43. In French, English, and Spanish.

The Ra's Hatibah region of the Red Sea has been mapped by the combined automatic processing and supervised classification of SPOT 1 HRV data. Steps in the present mapping procedure include the compiling of a three color composite, the crossing of data from SPOT channels X1 and X3, computing the 15 x 15 crossed histogram, a maximum likelihood classification, and cartographic synthesis. It is shown that the combined use of these two techniques achieves optimal interactivity between remote-sensing data and ground-truth data. It is noted that only features which were heterogeneous with respect to the pixel dimension, such as areas with sparse vegetation covering, could not be identified. R.R.

A88-46771#
NOISE AND TEMPERATURE GRADIENTS IN MULTICHANNEL SEA SURFACE TEMPERATURE IMAGERY OF THE OCEAN
PAUL E. LA VIOLETTE and RONALD J. HOLYER (U.S. Navy, Naval Ocean Research and Development Activity, Bay Saint Louis, MS) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, July 1988, p. 231-241. refs

A multispectral algorithm is routinely used to correct for atmospheric effects in NOAA AVHRR data to produce multichannel sea surface temperature (MCSST) imagery. However, the resulting imagery are of poor quality (i.e., with increased noise levels and reduced SST gradients) in comparison with the original Channels 4 and 5 imagery. The quality reduction is especially apparent in imagery of low thermal contrast areas. It is proposed that the increased noise results from the amplification of AVHRR Channels 4 and 5 random noise in the MCSST processing (thus the use of more channels, such as AVHRR Channel 3, will only increase MCSST noise). In support of this hypothesis, a model is presented for predicting MCSST noise levels from Channels 4 and 5 noise levels. The model is evaluated using two sample AVHRR image sets. Documentatioan of diminished sea surface temperature gradients in the MCSST imagery in comparison with the Channels 4 and 5 imagery is also presented and discussed. However, the exact cause for the reduction is not clear. Author

A88-47762
ENVIRONMENTAL INFLUENCES ON HURRICANE INTENSIFICATION
ROBERT T. MERRILL (Colorado State University, Fort Collins) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 45, June 1, 1988, p. 1678-1687. NOAA-supported research. refs (Contract NSF ATM-84-19116)

Although driven by internal processes, hurricanes are also regulated by conditions in their oceanic and atmospheric surroundings. Sea surface temperature determines an upper bound on the intensity of hurricanes, but most never reach this potential, apparently because of adverse atmospheric conditions. Winds measured by satellite cloud tracking, commercial aircraft, and rawinsondes are composited using a rotated coordinate system designed to preserve the asymmetries in the upper-tropospheric environment. Composite of upper-tropospheric environmental flows for intensifying and nonintensifying hurricanes for a five-year period are compared. Nonintensifying composites indicate stronger mean enrironmental flow relative to the hurricane motion, unidirectional flow over and near the hurricane center, and slightly weaker radial outflow and/or more pronounced anticyclonic flow surrounding the center in the upper troposphere. Author

A88-49077
A COMPUTATIONAL METHOD FOR ESTIMATING SEA ICE MOTION IN SEQUENTIAL SEASAT SYNTHETIC APERTURE RADAR IMAGERY BY MATCHED FILTERING
MICHAEL J. COLLINS (British Columbia, University, Vancouver, Canada) and WILLIAM J. EMERY (Colorado, University, Boulder) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Aug. 15, 1988, p. 9241-9251. Research supported by the Department of the Environment and NSERC. refs

This paper presents the results of a fully automated system to extract ice motion from an image pair. The problem of finding a field of displacements between two sequential images is posed as an estimation problem, and the system is shown to be an optimal solution to this problem. The performance of the system is shown to be superior to ice motion systems that use only cross correlation. The shortcomings of the system, and of area correlation in general, are outlined, and ways of overcoming them are suggested. Author

A88-49079
THE SPECTRAL IRRADIANCE FIELD AT THE SURFACE AND IN THE INTERIOR OF THE OCEAN - A MODEL FOR APPLICATIONS IN OCEANOGRAPHY AND REMOTE SENSING
SHUBHA SATHYENDRANATH (National Institute of Oceanography, Goa, India) and TREVOR PLATT (Bedford Institute of Oceanography, Dartmouth, Canada) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Aug. 15, 1988, p. 9270-9280. Sponsorship: NSERC-suported research. refs

A spectral model of irradiance is presented for the computation of light energy available at the surface and at various depths in the ocean for the wavelength range from 400 to 700 nm. For any latitude, irradiances are computed as a function of geographic location, data, and time. Application of the model is demonstrated through computation of the profiles of vertical attenuation coefficient and of the effective specific absorption of phytoplankton. The model results are compared with those from conventional procedures, which disregard spectral and angular distributions of the underwater light field, for calculation of the effective specific absorption. The magnitude of the errors incurred by such simplifications is estimated and is shown to be nonnegligible and variable with solar elevation, depth, and the phytoplankton pigment concentration in the water. Author

A88-49080
SPECULAR POINT SCATTERING CONTRIBUTION TO THE MEAN SYNTHETIC APERTURE RADAR IMAGE OF THE OCEAN SURFACE
DALE P. WINEBRENNER (Washington, University, Seattle) and KLAUS HASSELMANN (Max-Planck-Institut fuer Meteorologie, Hamburg, Federal Republic of Germany) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Aug. 15, 1988, p. 9281-9294. Navy-supported research. refs

The effect of specular point scattering on the mean SAR image of the ocean surface was investigated theoretically by including the specular point scattering mechanism in a model for the mean SAR image. It was found that the complete reflectivity variance spectrum is a sum of two terms, one due to Bragg scattering and the other due to specular point scattering. The specular point scattering image is characterized by a large Doppler broadening and by a relatively large Doppler shift in its reflectivity variance spectrum, so that the bandwidth of this image can easily exceed the bandwidth of a typical SAR processor, leading to a loss of mean image intensity. While for most ocean wave conditions and SAR incidence angles above 15 deg the specular point scattering contribution to the mean image intensity is small compared with the Bragg-scattering contribution, their contribution to the wave image contrast can become significant. I.S.

A88-49362
OCEAN DYNAMICS OBSERVED FROM SPACE USING SALYUT, COSMOS AND METEOR
B. A. NELEPO and G. A. GRISHIN (AN USSR, Morskoi Gidrofizicheskii Institut, Sevastopol, Ukrainian SSR) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1053-1070. refs

The technical and methodological fundamentals of ocean dynamics monitoring from satellites in the optical and microwave bands are briefly considered. The problems of visual-instrumental, numerical and optical data processing are discussed. Examples of photographic, scanner and radar observations from satellites are given, as well as the results of numerical processing and theoretical modeling of dynamical phenomena in the ocean and atmosphere; these include internal waves, currents, shelf water freshening and atmospheric cyclones. Author

A88-49364
SIGNIFICANT WAVEHEIGHT MEASUREMENT WITH H.F. RADAR
L. R. WYATT (Sheffield, University, England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1087-1095. Research supported by the Wolfson Foundation, Rijkswaterstaat of the Netherlands, and SERC. refs

High frequency radar measurements of significant wave height during two experiments in the Celtic Sea are discussed. A new algorithm has been developed which can be used to provide measurements of significant wave height with accuracies of about 12 percent relative to wave-buoy measurements. A dual-radar system is required for this measurement. For use with a single-radar system, some additional information on the directional properties of the wave spectrum are required. Author

A88-49367
BATHYMETRY STUDIES ON THE COASTAL WATERS (RED SEA) OF JEDDAH, SAUDI ARABIA, USING SHUTTLE MOMS-01 DATA
A. P. CRACKNELL and M. IBRAHIM (Dundee, University, Scotland) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1161-1165.

MOMS data recorded from the Space Shuttle flight STS-7 have been used to investigate water depths in the Red Sea in the vicinity of Jeddah, Saudi Arabia. An exponential relationship between pixel intensity (digital number) and water depth was observed. However, the rms deviation of the fit of the data to control points from the hydrographic charts for the area was about 3.7 m which is much too large for operational bathymetric work. The reason for this is the low sensitivity of the instrument and the nonsuitability of the spectral bands. Author

A88-49377*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A REVIEW OF SEA-STATE BIAS IN ALTIMETRY
ROBERT STEWART (California Institute of Technology, Jet

Propulsion Laboratory, Pasadena) World Ocean Circulation Experiment Altimeter Algorithm Workshop, Corvallis, OR, Aug. 24-26, 1987, Paper. 7 p. refs

The accuracy of satellite altimetric measurements of sea level is limited in part by the influence by ocean waves on the altimeter signal reflected from the sea surface. This error, termed the sea-state bias, is poorly known; yet, for such altimetric satellite missions as Topex/Poseidon, it is the largest source of error exclusive of those resulting from calculation of the satellite's ephemeris. Previous observations of sea-state bias have had a large, apparently random scatter, in the range of 1-5 percent of significant wave height; and the observations are not consistent with theoretical calculations of the bias. Further theoretical and experimental studies will be required for understanding the error with an accuracy required by future altimetric satellite missions. Author

A88-49399* Ohio State Univ., Columbus.
ON THE SIMULTANEOUS IMPROVEMENT OF A SATELLITE ORBIT AND DETERMINATION OF SEA SURFACE TOPOGRAPHY USING ALTIMETER DATA
THEODOSSIOS ENGELIS (Ohio State University, Columbus) Manuscripta Geodaetica (ISSN 0340-8825), vol. 13, 1988, p. 180-190. refs
(Contract NAG5-519; NAG5-781)

A method is presented in satellite altimetry that attempts to simultaneously determine the geoid and sea surface toography with minimum wavelengths of about 500 km and to reduce the radial orbit errors caused by geopotential uncertainties. The modeling of these errors is made using the linearized Lagrangian perturbation theory. Observation equations are developed using sea surface heights and crossover discrepancies as observables. A minimum variance solution with prior information can then provide estimates of parametrs representing the sea surface topography and corrections to the orbit. The potential of the method is demonstrated in a solution where simulated geopotential errors and the Levitus sea surface topography are used to generate the observables for a Seasat 3 day arc. The simulation results suggest that the method can be used to efficiently process real altimeter data. Author

A88-50281*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CZCS VIEW OF AN OCEANIC ACID WASTE DUMP
JANE A. ELROD (NASA, Goddard Space Flight Center, Greenbelt, MD) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 245-254. refs

Plumes from the acid waste dump in the New York Bight were visible in all nine cloud-free Coastal Zone Color Scanner images from April and May 1981. The CZCS subsurface radiance channels displayed consistent spectral characteristics, which consisted of a strong increase in the 550 nm channel and a moderate increase in the 520 nm channel relative to the surrounding coastal waters. The 443 nm channel showed no change or a slight decrease in radiance within the plumes. These anomalous radiances preclude the calculation of pigment in the dump plumes using existing algorithms. However, the high radiances of the 550 nm channel can be used to examine the flow patterns of surface water in the vicinity of the dump. Author

A88-50284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REFLECTANCES OF GLACIERS AS CALCULATED USING LANDSAT-5 THEMATIC MAPPER DATA
DOROTHY K. HALL, ALFRED T. C. CHANG (NASA, Goddard Space Flight Center, Greenbelt, MD), and HONNAPPA SIDDALINGAIAH (SEA Corp., Gaithersburg, MD) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 311-321. refs

Landsat-5 digital numbers have been used to compute the at-satellite planetary reflectance on spectrally similar zones on the Meares and Schwanda glaciers in Alaska and the Grossglockner glacier group in Austria. The patterns of TM-derived reflectances in the ablation areas of the Grossglockner glacier group and the Meares Glacier compare favorably with published reflectance curves measured on the surface of glacier ice, though the surface reflectance of snow-covered ice is higher than the Landsat-derived reflectance for the glaciers studied. The accuracy of the at-satellite planetary reflectances is shown to be affected by topographic and atmospheric effects and by the anisotropic nature of snow reflectance. Author

A88-50686
MEASUREMENT OF SOME SEA-SURFACE PARAMETERS USING CENTIMETER-RANGE COHERENT RADAR [IZMERENIE NEKOTORYKH PARAMETROV MORSKOI POVERKHNOSTI KOGERENTNOI RADIOLOKATSIONNOI STANTSIEI SANTIMETROVOGO DIAPAZONA]
A. K. SAVCHENKO (B'lgarska Akademiia na Naukite, Institut po Elektronika, Sofia, Bulgaria; AN USSR, Institut Radiofiziki i Elektroniki, Kharkov, Ukrainian SSR) Radiofizika (ISSN 0021-3462), vol. 31, no. 6, 1988, p. 639-644. In Russian. refs

The Doppler spectrum of sea-surface echoes obtained in the centimeter radio wave range using a coherent radar is studied. It is shown that wave crests make the main contribution to the Doppler clutter spectrum in the case of horizontal polarization. K.K.

A88-50687
THE THEORY OF SAR IMAGING OF THE SEA SURFACE [K TEORII RSA-IZOBRAZHENIIA MORSKOI POVERKHNOSTI]
M. B. KANEVSKII (AN SSSR, Institut Prikladnoi Fiziki, Gorki, USSR) Radiofizika (ISSN 0021-3462), vol. 31, no. 6, 1988, p. 645-651. In Russian. refs

An SAR image spectrum of the sea surface is analyzed in the case where surface wave imaging is influenced by the slope modulation of the backscattering cross section. It is shown that the signal-to-noise ratio increases with an increase in the synthesis interval. K.K.

A88-52192
DATA ANALYSIS OF A COASTAL ZONE REMOTE SENSING CAMPAIGN BY THE NASA C130 AIRPLANE
I. PIPPI and B. RADICATI (CNR, Istituto di Ricerca sulle Onde Elettromagnetiche, Florence, Italy) IN: Applications of digital image processing X; Proceedings of the Meeting, San Diego, CA, Aug. 19-21, 1987. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 305-309. refs

Sensors now available for sea monitoring were tested in a remote sensing campaign over the seas around Italy using the NASA C130 aircraft. The sensors are described, including the NSOO1 Thematic Mapper Simulator, the Thermal Infrared Multispectral Scanner, and the Airborne Imaging Spectrometer. The data reduction taking the instrumental noise and errors, flight parameters and geometric corrections, physical units reduction and calibration, and atmospheric correction is addressed. Some applications of the findings are briefly examined. C.D.

A88-52455#
REMOTE SENSING TECHNIQUES FOR CORAL REEF STUDIES
I. FAGOONEE (University of Mauritius, Reduit) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 439-450. refs

Coral reefs may extend over large areas; conventional survey and mapping methods relying on aerial photography, nautical charts and underwater observations are inadequate, and pose technical and financial problems. It has been proved that remote sensing provides a considerably less expensive alternative technology, permitting the regular monitoring of the status of reefs and the impacts of environmental stress and pollution. These are reviewed here. The various steps involved in processing satellite data for automatic reef cartography and work already accomplished in this area are briefly described. The future of remote sensing in reef studies is also outlined. Author

A88-52456#
MARINE APPLICATIONS OF ARGOS
MICHEL TAILLADE (CNES, Service ARGOS, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 451-462.

Since October 1978, Argos is known worldwide to be a unique French-American system of satellite-based location and data collection. It will offer a continuous service throughout the Tiros-N satellite program well after 1995. Marine applications are a major part of the Argos activity: oceanography (currents, waves, sea studies) but also meteorology, climatology, marine biology. Industrial applications such as offshore activities (exploration and exploitation), fishing, merchant marine and harbor constructions do represent an increasing part of the Argo's market. Author

A88-52541#
A REMOTE SENSING METHOD FOR MARINE SHORELAND SURVEY
DUOFEN HE (Beijing Scientific Institute of Petroleum, People's Republic of China) and CHENGYE DONG (Regional Planning Office, Weifang, People's Republic of China) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1449-1456. Research supported by the National Planning Committee of China.

A method for surveying shoreland using Landsat data and records of tidal positions is presented. The method was tested for the Laizhou Bay in China, using MSS-5 and MSS-6 imagery collected in November 1976 and May 1977. The methods used to determine the critical elevations of the tideland, to select, analyze and interpret Landsat images, and to estimate the area of different classes of shoreland are outlined. Tables of tide array and frequencies estimates and maps prepared during the survey are given. R.B.

A88-52543#
REMOTE SENSING DATA APPLIED TO MANGROVES OF KENYA COAST
F. BLASCO, F. LAVENU (Institut de la Carte Internationale du Tapis Vegetal, Toulouse, France), and J. BARAZA (Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1465-1480. refs

A88-53720
A SIMPLE PREDICTION METHOD FOR L-BAND MULTIPATH FADING IN ROUGH SEA CONDITIONS
YOSHIO KARASAWA and TAKAYASU SHIOKAWA (Kokusai Denshin Denwa Co., Ltd., Meguro Research Laboratories, Tokyo, Japan) IEEE Transactions on Communications (ISSN 0090-6778), vol. 36, Oct. 1988, p. 1098-1104. refs

Quantitative analysis of the coherent and incoherent power of sea-reflected waves at 1.5 GHz was performed using multipath-fading data obtained by field experiments. The experiments were carried out for shore-to-shore, satellite-to-shore, and satellite-to-ship paths, and antennas with gains from 13 dBi to 21 dBi were used for signal reception. Results indicate that in rough sea conditions where the incoherent component is dominant, the power of the incoherent component can reach the maximum power of the coherent component (generated in calm sea) in most cases, except for a few cases such as when measurements using narrow-beam antennas or elevation angles below 7 deg are made. On the results obtained, a simple prediction method for multipath fading caused by sea reflection is presented. I.E.

A88-54800* Stanford Univ., Calif.
RECRUITMENT DYNAMICS IN COMPLEX LIFE CYCLES
JONATHAN ROUGHGARDEN, HUGH POSSINGHAM (Stanford University, CA), and STEVEN GAINES (Brown University, Providence, RI) Science (ISSN 0036-8075), vol. 241, Sept. 16, 1988, p. 1460-1466. refs
(Contract DE-FG03-85ER-60362; NCA2-258)

Factors affecting marine population fluctuations are discussed with particular attention given to a common barnacle species of the Pacific coast of North America. It is shown how models combining larval circulation with adult interactions can potentially forecast population fluctuations. These findings demonstrate how processes in different ecological habitats are coupled. K.K.

A88-55068
COMPARISON OF SEA SURFACE WIND MEASUREMENTS OBTAINED FROM BUOY, AIRCRAFT AND ONSHORE MASTS DURING THE TOSCANE T CAMPAIGN
N. DANIAULT, M. CAMBLAN, J. N. THEPAUT (Etablissement d'Etudes et de Recherches Meteorologiques, Brest, France), and M. CHAMPAGNE-PHILIPPE (Institut Francais de Recherche pour l'Exploitation de la Mer, Brest, France) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 5, June 1988, p. 385-404. refs

Simultaneously recorded sea surface wind measurements obtained from different sources are compared as part of the 'TOSCANE' program for the calibration and validation of scatterometers and altimeters for use in future satellites. Measurements were taken from network of coastal masts, a buoy 6 km offshore, and an aircraft flying at a nominal altitude of 100 m. Mean differences between mast and buoy measurements were 0.4 m/s for speed and -9 deg. for direction, with standard deviations of 0.8 m/s and 9 deg. These differences were largely due to truncation of the buoy data to the knot, and to the 36-direction compass card. Aircraft and mast mean differences were -0.4 m/s and 7 deg with standard deviations of 0.9 m/s and 10 deg. Comparison of aircraft and mast measurements show that atmospheric situations must be analyzed before being used in scatterometer calibration. R.B.

A88-55128* California Univ., Santa Barbara.
VARIABILITY OF PIGMENT BIOMASS IN THE CALIFORNIA CURRENT SYSTEM AS DETERMINED BY SATELLITE IMAGERY. I - SPATIAL VARIABILITY
RAYMOND C. SMITH, XUEYUN ZHANG, and JOEL MICHAELSEN (California, University, Santa Barbara) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Sept. 20, 1988, p. 10863-10882. refs
(Contract NAGW-273; NAGW-290)

Spatial variability of chlorophyll in the California Current system was analyzed using Coastal Zone Color Scanner (CZCS) imagery. A total of 48 images were analyzed to produce seasonal averages and variances, gradients, and power spectra. Roughly one third to one half of the variance in pigment biomass can be explained by consistent, large-scale gradients. In general, biomass is higher in the north and in nearshore areas. Nearshore areas also have proportionally more small-scale variability than the areas offshore. Slopes of the power spectra for nearshore areas are about -2.2 (for spatial scales of 10-100 km), while slopes for offshore areas are about -3. In addition, the power spectra show evidence of a change in slope at about 10 km, with slopes of about -1 for shorter-length scales. This may indicate that biological processes dominate the smaller scales, while mesoscale eddies and geostrophic currents dominate the larger scales. Author

A88-55129* California Univ., Santa Barbara.
VARIABILITY OF PIGMENT BIOMASS IN THE CALIFORNIA CURRENT SYSTEM AS DETERMINED BY SATELLITE IMAGERY. II - TEMPORAL VARIABILITY
JOEL MICHAELSEN, XUEYUN ZHANG, and RAYMOND C. SMITH (California, University, Santa Barbara) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Sept. 20, 1988, p. 10883-10896. refs
(Contract NAGW-273; NAGW-290)

Characteristics of temporal variability in the California Current system are analyzed using a 30-month time series of CZCS imagery.

About 20-25 percent of the variance is produced by a periodic annual cycle with peak values in winter. Analysis of ship-based chlorophyll measurements indicates that the winter peak is only characteristic of the upper portion of the euphotic zone and that total water column chlorophyll peaks during the spring upwelling season. Satellite studies of intraannual variability are modulated by strong 5- to 6-day oscillation in the availability of usable imagery, resulting from a combination of satellite orbital dynamics, which produces images of the study area roughly 4 out of every 6 days, and an oscillation in cloud cover, which controls the availability of clear imagery. The cloud cover oscillation, which is also present in coastal winds, undoubtedly affects the ocean surface and biases the data obtained by satellites. Analysis of data using a 5-day time step indicates that the predominant mode of nonseasonal variability is characterized by in-phase fluctuations throughout the southern and central California coastal region. Author

A88-55130* Miami Univ., Coral Gables, Fla.
A SEMIANALYTIC RADIANCE MODEL OF OCEAN COLOR
HOWARD R. GORDON, JAMES W. BROWN (Miami, University, Coral Gables, FL), OTIS B. BROWN, ROBERT H. EVANS (Miami, University, FL), RAYMOND C. SMITH (California, University, Santa Barbara) et al. Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Sept. 20, 1988, p. 10909-10924. refs
(Contract NAGW-273; NAGW-290; NAG5-811)

A semianalytical radiance model is developed which predicts the upwelled spectral radiance at the sea surface as a function of the phytoplankton pigment concentration for Morel Case 1 waters. The model is in good agreement with experimental measurements carried out in waters which were not included in the data base used to derive it. It suggests that the observed variability in the radiance is due to variations in the backscattering of plankton and the associated detrital material. The model is extended to include other material in the water, such as dissolved organic material, referred to as yellow substances, and detached coccoliths from coccolithophorids, e.g., Emiliana huxleyi. Potential applications include an improved biooptical algorithm for the retrieval of pigment concentrations from satellite imagery in the presence of interference from detached coccoliths and an improved atmospheric correction for satellite imagery. The model also serves to identify and to interpret deviations from Case 1 waters.
Author

A88-55145* Tel-Aviv Univ. (Israel).
THE MILANKOVITCH THEORY AND CLIMATE SENSITIVITY. I - EQUILIBRIUM CLIMATE MODEL SOLUTIONS FOR THE PRESENT SURFACE CONDITIONS. II - INTERACTION BETWEEN THE NORTHERN HEMISPHERE ICE SHEETS AND THE CLIMATE SYSTEM
BINYAMIN U. NEEMAN, GEORGE OHRING (Tel Aviv University, Israel), and JOACHIM H. JOSEPH (NASA, Goddard Space Flight Center, Greenbelt, MD; Tel Aviv University, Israel) Journal of Geophysical Research (ISSN 0148-0227), vol. 93, Sept. 20, 1988, p. 11153-11191. refs

A seasonal climate model was developed to test the climate sensitivity and, in particular, the Milankovitch (1941) theory. Four climate model versions were implemented to investigate the range of uncertainty in the parameterizations of three basic feedback mechanisms: the ice albedo-temperature, the outgoing long-wave radiation-temperature, and the eddy transport-meridional temperature gradient. It was found that the differences between the simulation of the present climate by the four versions were generally small, especially for annually averaged results. The climate model was also used to study the effect of growing/shrinking of a continental ice sheet, bedrock sinking/uplifting, and sea level changes on the climate system, taking also into account the feedback effects on the climate of the building of the ice caps. I.S.

A88-55187* Texas Univ., Austin.
CIRCULATION FROM A JOINT GRAVITY FIELD SOLUTION DETERMINATION OF THE GENERAL OCEAN
B. D. TAPLEY, R. S. NEREM, C. K. SHUM, J. C. RIES, and D. N. YUAN (Texas, University, Austin) Geophysical Research Letters (ISSN 0094-8276), vol. 15, Sept. 1988, p. 1109-1112. refs
(Contract JPL-958122)

With the development of satellite altimetry, it is possible to infer the geostrophic velocity of the surface ocean currents, if the geoid and the position of the satellite are known accurately. Errors in current geoid models and orbit computations, both due primarily to errors in the earth's gravity field model, have limited the use of altimeter data for this purpose. The objective of this investigation is to demonstrate that altimeter data can be used in a joint solution to simultaneously estimate the quasi-stationary sea surface topography, zeta, and the model for the gravity field. Satellite tracking data from twelve satellites were used along with Seasat altimeter data for the solution. The estimated model of zeta compares well at long wavelengths with the hydrographic model of zeta. Covariance analysis indicates that the geoid is separable from zeta up to degree 9, at which point geoid error is comparable to the signal of zeta. Author

A88-55188* California Univ., La Jolla.
AN ATTEMPT TO REMOTELY SENSE FROM SPACE THE SURFACE HEAT BUDGET OVER THE INDIAN OCEAN DURING THE 1979 MONSOON
CATHERINE GAUTIER (California, University, La Jolla) and ROBERT FROUIN (Ecole Normale Superieure, Paris, France) Geophysical Research Letters (ISSN 0094-8276), vol. 15, Sept. 1988, p. 1121-1124. refs
(Contract NAGW-0981)

Satellite data are used to estimate the net surface heat flux (Q) over the Indian Ocean during June 1979. Ten-day and monthly average fields of Q and its components are produced and analyzed in relation to monsoon dynamics. When compared to ship-based estimates, the satellite-derived fluxes exhibit correct orders of magnitude and their temporal evolution is consistent with the present monsoon knowledge. This study, which represents a first attempt to remotely sense from space the earth surface net heat flux, demonstrates that current satellite sensor data can be combined to accurately describe net heat flux changes in areas such as the Arabian Sea, where they are large, rapid, and spatially extended, and therefore not fully observed by ships. Author

A88-55242
OCEANIC PRIMARY PRODUCTION - ESTIMATION BY REMOTE SENSING AT LOCAL AND REGIONAL SCALES
TREVOR PLATT (Bedford Institute of Oceanography, Dartmouth, Canada) and SHUBHA SATHYENDRANATH (National Institute of Oceanography, Goa, India) Science (ISSN 0036-8075), vol. 241, Sept. 23, 1988, p. 1613-1620. refs

A method for deriving an estimate of primary production from remotely sensed data on ocean color is presented. An attempt is made to recover the primary production per unit area of sea surface, the quantity of greatest ecological interest. An algorithm that combines a spectral and angular model of submarine light with a model of the spectral response of algal photosynthesis is studied.
K.K.

A88-55346#
ASPECTS OF DETERMINATION OF OCEAN WAVE PARAMETERS BY MEANS OF AN OPTOELECTRONIC SATELLITE SENSOR
HERBERT JAHN, DIETER OERTEL, RAINER SANDAU, and GERHARD ZIMMERMANN (Akademie der Wissenschaften der DDR, Institut fuer Raumforschung, Berlin, German Democratic Republic) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 9 p. refs
(IAF PAPER 88-154)

A simulation study is presented, concerning the use of an optoelectronic spaceborne sensor system with CCD lines and a digital two-dimensional Fourier transform device to determine ocean wave parameters. The simulation used a sinusoidal wave pattern with different propagation directions in relation to the sensor viewing angle and the sun elevation angle. It was found that the optimization of the sounding direction is important in determining wave

parameters at given sun angles. It was shown that the sensors were able to analyze an area of about 5 X 5 km, even under partially cloudy conditions. Several types of transforms, their implementation requirements, and data compression estimates are compared, making it possible to characterize the bottlenecks of an optoelectronic sensor system. R.B.

A88-55347#
EXPLORATION OF FISHERY RESOURCES USING REMOTELY SENSED DATA - A CASE STUDY FOR KERALA COAST OF INDIA
BEENA KUMARI, P. C. MANKODI, H. U. SOLANKI, R. M. DWIVEDI, A. NARAIN (ISRO, Space Applications Centre, Ahmedabad, India) et al. IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p. refs
(IAF PAPER 88-156)

A88-55481
THE ROLE OF THE EQUATORIAL HEAT SOURCES IN THE WESTERN PACIFIC OCEAN ON THE ONSET OF THE ASIAN SUMMER MONSOONS OF 1986
KEN-ICHI KUMA (Japan Meteorological Agency, Tokyo) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 66, June 1988, p. 399-417. refs

The relationship between the equatorial heat sources and the development of large-scale circulation that was observed for the onsets of monsoons in the early summer of 1986 and in the FGGE year was compared with the results of predictive experiments in which the convective heating over the equatorial region was controlled for two transition periods in 1986, using a nonlinear forecast model. In these experiments, the heat source over the domain from 30 S to 30 N and 90 E to 170 W was estimated from the cloud-top temperature measured by the Japanese Geostationary Meteorological Satellite. The results confirmed that the equatorial heat source away from the monsoon region plays an important role in generating the anticyclone over South Asia at 200 mb. I.S.

N88-26002*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUGGESTED HURRICANE OPERATIONAL SCENARIO FOR GOES I-M
W. P. MENZEL, R. T. MERRILL (Wisconsin Univ., Madison.), and W. E. SHENK Dec. 1987 20 p
(NASA-TM-89729; NAS 1.15:89729; PB88-184817; NOAA-TM-NESDIS-19) Avail: NTIS HC A03/MF A01 CSCL 04B

Improvements in tropical cyclone forecasts require optimum use of remote sensing capabilities, because conventional data sources cannot provide the necessary spatial and temporal data density over tropical and subtropical oceanic regions. In 1989, the first of a series of geostationary weather satellites, GOES 1-M, will be launched with the capability for simultaneous imaging and sounding. Careful scheduling of the GOES 1-M will enable measurements of both the wind and mass fields over the entire tropical cyclone activity area. The document briefly describes the GOES 1-M imager and sounder, surveys the data needs for hurricane forecasting, discusses how geostationary satellite observations help to meet them, and proposes a GOES 1-M schedule of observations and hurricane relevant derived products. GRA

N88-26014*# National Aeronautics and Space Administration, Washington, D.C.
REMOTE DETERMINATION OF CHLOROPHYLL CONCENTRATION IN THE OCEAN USING AN OPTICAL PULSE RADAR
I. M. LEVIN and K. S. SHIFRIN Jun. 1988 13 p Transl. into ENGLISH from Distantsionnoye Opredeleniye Kontsentratsii Khlorofilla v Okeane s Pomoshchyu Opticheskogo Impulsnogo Lokatora, Issledovaniye Zemli iz Kosmosa (USSR), Jul.-Aug. 1987 p 12-19 Original language document was announced in IAA as A88-19562 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASW-4307)
(NASA-TT-20301; NAS 1.77:20301) Avail: NTIS HC A03/MF A01 CSCL 08C

The potential of the pulse grating method to determine chlorophyll concentrations in the ocean are discussed. Relationships are derived for the power and energy of the echo signal. Two methods are proposed to calculate the water absorption coefficient, one for daytime applications and the other to be used at night. The radar energy sensitivity is evaluated (also in the presence of interfering sunlight). By way of example, required radar power and energy are calculated for real world conditions. Author

N88-26053# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
OVERVIEW OF SPACE MISSIONS AND TECHNIQUES FOR OCEAN MONITORING
N. DEVILLIERS *In its* Proceedings of the Colloquium on Space and Sea p 265-272 Mar. 1988
Avail: NTIS HC A15/MF A01

Past, present, and future space missions contributing to the monitoring of ocean phenomena for scientific and operational applications are reviewed. The merits of satellite techniques are discussed and the major classes of sensors used for oceanographic applications are presented together with their measurement performances. Aspects related to orbits, data acquisition, processing, and dissemination are also covered. ESA

N88-26055# International Chamber of Shipping, London (England).
THE CONTRIBUTION OF SPACE TO MARITIME ACTIVITIES
M. A. CALDER *In* ESA, Proceedings of the Colloquium on Space and Sea p 281-286 Mar. 1988
Avail: NTIS HC A15/MF A01

The contribution of space to maritime activities, where the space vehicle itself provides a maritime function or where space provides the relay of communications is reviewed. The need for monitoring the meteorological and hydrographic maritime environment increases in order to safeguard sophisticated but more vulnerable ships. Equally important is to know their position accurately and, in a casualty to provide effective communications to locate and rescue of survivors. Space demonstrates its ability to provide quality telecommunications to shipping for all these purposes. ESA

N88-26056# Centre National d'Etudes Spatiales, Toulouse (France).
SENSORS IN SPACEBORNE OCEANOGRAPHY [LES CAPTEURS EN OCEANOGRAPHIE SPATIALE]
M. AVIGNON and M. DORRER *In* ESA, Proceedings of the Colloquium on Space and Sea p 287-296 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

Passive spaceborne oceanographic sensors; optical radiometers; infrared and microwave devices; active senors; side looking radar and altimeters; positioning systems; and data acquisition systems are reviewed. Orbital considerations in spaceborne oceanography are mentioned. ESA

N88-26058# Centre National d'Etudes Spatiales, Toulouse (France).
THE FRENCH SPACEBORNE OCEANOGRAPHY PROGRAM [LE PROGRAMME FRANCAIS D'OCEANOGRAPHIE SPATIALE]
JEAN-LOUIS FELLOUS and B. VOITURIEZ (Ifremer, Paris, France) *In* ESA, Proceedings of the Colloquium on Space and Sea p 305-310 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

The French space oceanography program is aimed at improving knowledge and understanding of the oceans and of their role in climate and climate change, through the development and use of space techniques. Another objective is to prepare for potential applications of ocean observations from space. The program encompasses the various fields of ocean research and involves a

series of flight instruments and dedicated satellite missions. Techniques to be used include altimetry, scatterometry, visible, infrared and microwave radiometry, precise tracking (DORIS) as well as data collection and localization systems (ARGOS). An important effort is devoted to ocean data archiving and processing (projects CERSAT and AVISO). Eight major French research institutions coordinate their activities in space oceanography in the framework of GREOS. The whole program is largely based on international cooperation and is closely related to the world research programs on climate (WCRP) and the ocean (TOGA, WOCE, GOFS). Projects under development include TOPEX/POSEIDON, a dedicated altimetric satellite mission; ATSR/M, a passive microwave radiometer for ERS-1; and Vegetation, a large swath medium resolution radiometer to be flown onboard the SPOT 4 satellite. ESA

N88-26059# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
THE CERSAT ARCHIVING AND PROCESSING CENTER [LE CENTRE ERS POUR L'ARCHIVAGE ET LE TRAITEMENT (CERSAT)]
PATRICK FARCY and A. CAVANIE *In* ESA, Proceedings of the Colloquium on Space and Sea p 311-316 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

The center for the reception, control, archiving processing, and dissemination of ERS-1 low bit rate data from the radars, wind scatterometer, altimeter, and wave scatterometer is presented. Main users are scientists involved in oceanography, and clients needing ocean and climate data such as the offshore industry, navigation, coastal management. Extension of the services offered to include the TOPEX POSEIDON, NROSS and similar programs is envisaged. ESA

N88-26060# Alcatel Thomson Espace, Toulouse (France).
DETERMINATION OF THE OCEAN CIRCULATION BY SPACEBORNE RADAR ALTIMETER
PIERRE DECHATEAU-THIERRY *In* ESA, Proceedings of the Colloquium on Space and Sea p 317-321 Mar. 1988
Avail: NTIS HC A15/MF A01

The TOPEX/POSEIDON joint mission of the NASA experiment TOPEX (Ocean Topography Experiment) and the French POSEIDON program is introduced. The purpose of the mission is the accurate measurement of the sea surface to assess ocean currents in order to improve knowledge of ocean circulation and its variability in mesoscale. The POSEIDON radar altimeter is a design mixing the advantage of the SEASAT architecture, the potential of advanced technology, and the knowledge of operational requirements that comes from SEASAT results. It is a single-frequency radar altimeter operating at a pulse repetition frequency of 1700 Hz. The center frequency is 13.65 GHz, bandwidth 320 MHz, and pulse duration 100 microsec. Samples are produced by the FFT-SA at a rate of 10 KHz which, in turn, defines the length of the short, or compression pulse (the interval between samples produced at a rate of 10 KHz is 10/3.2 ns or 3.125 ns). The pulse compression ratio is 320 MHz/10 KHz or 100 microsec/3.125 ns, i.e., 32,000:1. The radiated power rating is 5 W while the gain of the 1.2 m diameter antenna is estimated at 42 dB. The echo generator test bench is described. ESA

N88-26061# Bureau Veritas, Courbevoie (France).
OCEAN SATELLITE DATA AND THE NEEDS OF DESIGNERS AND OPERATORS OF MARINE UNITS
MICHEL HUTHER and R. NERZIC (Elf Aquitaine, Pau, France) *In* ESA, Proceedings of the Colloquium on Space and Sea p 323-325 Mar. 1988 In FRENCH; ENGLISH summary
Avail: NTIS HC A15/MF A01

Satellite programs oriented to the study of oceans, in particular the European program of ERS-1 are reviewed. The projected studies are mainly scientific, to obtain a better knowledge of parameters defining environment. Among the defined measurements, parameters are of interest for professionals working on marine subjects, particularly wind and waves. The designers and operators of marine units, such as offshore platforms and ships, are users of data on sea states and environmental conditions. The data are necessary during the various phases of a project, site evaluation, strength calculations, and operation surveys. For the ERS-1 project an altimeter to provide data on the wave profile along the satellite track, i.e., in one direction only, and a SAR imaging radar which provides a wide view of the sea surface are planned. ESA

N88-26063# Centre National de la Recherche Scientifique, Paris (France).
CONTRIBUTION OF SPACEBORNE HIGH RESOLUTION RADIOMETERS TO MAPPING OF PRECOASTAL DEPTHS [APPORTS RADIOMETRES A HAUTE RESOLUTION SPATIALE POUR LA CARTOGRAPHIE DES HAUTS FONDS PRE LITTORAUX]
A. T. DIAW, E. GUILLEMOT, L. MENANTEAU, Y.-F. THOMAS, R. ZBINDEN, and C. A. A. AMAYA *In* ESA, Proceedings of the Colloquium on Space and Sea p 333-338 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

High resolution radiometric imagert from the SPOT HRV instrument of the Atlantic coast off the Saloum (Senegal) tidal delta and of the Rosario Archipelego (Columbia) was analyzed. Bathymetric and turbidity maps of the areas are presented. The usefulness of the SPOT images in revealing reef structures and in explaining the morphodynamic evolution of the sediment structures which hinder navigation in the mouth of the Saloum is shown. ESA

N88-26065# Ecole Nationale Superieure des Mines, Valbonne (France).
IMAGE PROCESSING APPLIED TO QUANTITATIVE NUMERICAL CARTOGRAPHY OF OCEAN CIRCULATION [TRAITEMENT D'IMAGES APPLIQUE A LA CARTOGRAPHIE NUMERIQUE QUANTITATIVE DE LA CIRCULATION OCEANIQUE]
B. BIANCHI and L. WALD *In* ESA, Proceedings of the Colloquium on Space and Sea p 345-347 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

A numerical method for calculating ocean surface currents is presented. It uses a pair of satellite thermographs, which are employed to solve an unsteady advection equation of the heat in each pixel of the image. Application to a vortex in the Gulf Stream show the usefulness of the method. ESA

N88-26066# Ecole Nationale Superieure des Mines, Valbonne (France).
METHODS FOR PROCESSING SATELLITE IMAGES AND THEIR APPLICATION TO UNDERWATER OPERATIONS [LES METHODES DE TRAITEMENT D'IMAGES SATELLITAIRES ET LEUR APPLICATION AUX TRAVAUX SOUS-MARINS]
L. WALD *In* ESA, Proceedings of the Colloquium on Space and Sea p 349-351 Mar. 1988 In FRENCH
Avail: NTIS HC A15/MF A01

The principals of digital processing of Earth observation satellite images of the ocean are recalled. The similarity between problems encountered in this domain and the processing of underwater images is pointed out. The application of space image processing techniques to underwater imagery is discussed. ESA

N88-26765# National Oceanic and Atmospheric Administration, Seattle, Wash. Marine Environmental Lab.
NUMERICAL MODEL FOR THE COMPUTATION OF RADIANCE DISTRIBUTIONS IN NATURAL WATERS WITH WIND-ROUGHENED SURFACES
C. D. MOBLEY and R. W. PREISENDORFER Jan. 1988 203 p Prepared in cooperation with Washington Univ., Seattle (PB88-192703; NOAA-TM-ERL-PMEL-75; CONTRIB-813) Avail: NTIS HC A10/MF A01 CSCL 04B

This report is a repository of the details of derivation of a numerical procedure to determine the unpolarized radiance distribution as a function of depth, direction, and wavelength, in a

natural hydrosol such as lake or sea. The input to the model consists of (1) the incidence radiance distribution at the air-water surface, (2) the state of randomness of the air-water surface as a function of wind speed, (3) the volume scattering and volume attenuation functions of the medium as a function of depth and wavelength, and (4) the type of bottom boundary. The model has an expandable library of derived quantities that are of use in various applications of optics to natural waters, such as marine biological studies, underwater visual search tasks, remote sensing, and climatology. GRA

N88-26779# National Academy of Sciences - National Research Council, Washington, D. C. Ad Hoc Committee on Antarctic Physical and Chemical Oceanography.
PHYSICAL OCEANOGRAPHY AND TRACER CHEMISTRY OF THE SOUTHERN OCEAN
1988 140 p
(Contract DE-FG01-84ER-60266)
(DE88-006852; DOE/ER-60266/T2) Avail: NTIS HC A07/MF A01

This report considers technical and scientific developments and research questions in studies of the Southern Ocean since its predecessor, Southern Ocean Dynamics--A Strategy for Scientific Exploration 1973-1983 was published. The summary lists key research questions in Southern Ocean oceanography. Chapter 1 describes how Southern Ocean research has evolved to provide the basis for timely research toward more directed objectives. Chapter 2 recommends four research programs, encompassing many of the specific recommendations that follow. Appendix A provides the scientific background and Reference/Bibliography list for this report for: on air-sea-ice interaction; the Antarctic Circumpolar Current; water mass conversion; chemical tracer oceanography; and numerical modeling of the Southern Ocean. Appendix B describes the satellite-based observation systems expected to be active during the next decade. Appendix C is a list of relevant reports published during 1981-1987. DOE

N88-26782# Alaska Univ., Fairbanks. Geophysical Inst.
ARCTIC ICE ISLAND AND SEA ICE MOVEMENTS AND MECHANICAL PROPERTIES Quarterly Report No. 14, 1 Jan. - 31 Mar. 1987
W. M. SACKINGER and M. O. JEFFRIES 1987 31 p
(Contract DE-AC21-83MC-20037)
(DE88-004267; DOE/MC-20037/T1) Avail: NTIS HC A03/MF A01

The research program on ice islands has four elements: (1) through the use of satellite imagery, historical records, and aerial photography, to establish a time history of all of the Arctic ice shelves, and thus an historically verified source for ice islands; (2) to establish postioning buoys on the known existing ice islands to track their trajectories daily and to telemeter daily barometer pressure and temperature, via System Argos; (3) to calculate geostrophic winds from global pressure maps and barometric pressure data from the buoys, and relate the observed ice island trajectories to the winds and the internal pack ice forces; (4) to construct a model for ice island motion which will enable a determination of the probability of interaction between ice islands and offshore structures, and which will be verified by comparsion with the experimentally observed trajectory data. Research activities covered in the fourteenth quarter include; ice islands (buoy operation and ice island motion); and mechanical properties of sea spray ice bonds to structures. DOE

N88-27617# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ACTIVE AND PASSIVE REMOTE SENSING OF ICE Semiannual Progress Report, 1 Aug. 1987 - 31 Jan. 1988
JIN A. KONG 31 Jan. 1988 13 p
(Contract N00014-83-K-0258)
(AD-A193307) Avail: NTIS HC A03/MF A01 CSCL 20N

Volume scattering effects of snow-covered sea ice are studied with a three-layer random medium model for microwave remote sensing. The strong fluctuation theory and the bilocal approximation are applied to calculate the effective permittivities for snow and sea ice. Remote sensing of sea ice is studied with the two-layer random medium model where a correlation function is used to characterize the randomly fluctuating part of the permittivity. A systematic approach for the identification of terrain media is developed using the optimum polarimetric classifier. The covariance matrices for various terrain cover are computed from theoretical models of random medium by evaluating the full polarimetric scattering matrix elements. The Mueller matrix and polarization covariance matrix are described for polarimetric radar systems. The clutter is modelled by a layer of random permittivity, described by a three-dimensional correlation function, with variance, and horizontal and vertical correlation lengths. Electromagnetic waves scattering from a randomly perturbed periodic surface is solved using the Extended Boundary Condition method. We have also derived a general mixing formula for discrete scatterers immersed in a host medium. GRA

N88-28361 British Antarctic Survey, Cambridge (England).
TOPOGRAPHY OF AN ANTARTIC ICE STREAM
D. G. VAUGHAN, C. S. M. DOAKE, and D. R. MANTRIPP *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 167-174 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Comparison between a SPOT image taken on 8 Jan. 1987 and a LANDSAT image of 3 Feb. 1974 shows that surface topographic patterns on Rutford Ice Stream, Antarctica were displaced downstream by several kilometers. Ice velocities derived from these movements agree with measurements made by ground based surveys in the near vicinity. Because the surface topography is thought to reflect partial grounding of the glacial sole, the implication is that the substrate to the ice stream is mobile. This has important implications for the dynamic behavior of the ice stream and its reaction to climatic changes. Pixel radiance values from the SPOT images were compared with surface slopes measured along a detailed level line by a ground based survey in Feb. 1987. There is a strong relationship between slope and radiance, suggesting that deriving quantitative topographic data from single SPOT images is possible. ESA

N88-28461 Centre National de la Recherche Scientifique, Paris (France).
THE USE OF SPOT DATA IN MAPPING COASTAL AREAS
F. VERGER and PH. REBILLARD (Societe Europeenne de Propulsion, Puteaux, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1079-1085 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

An area on the French Atlantic coast was studied using SPOT, TM, MSS, and Seasat SAR data registered to the corresponding topographic maps at the scale of 1:25,000. Two test sites were studied: a sand pit showing a fast evolution, and an intertidal area, which shows heavy turbidity and halophyte vegetation. The test zones are covered by Halocene and deposits made up of marshlands, tidal flats and sand-pits. It is characterized by a low relief. Vegetation is made up of halophytes. The study was carried out using 4 SPOT images acquired in April, June, August and September 1986, taken at different tides. The SPOT data were contrasted to the MSS, TM, and Seasat data acquired in 1974, 1984, and 1978 respectively. The results show the resolution capability of SPOT versus Seasat SAR and TM in mapping tidal areas; the high accuracy of the registration procedure; and the ability of SPOT to acquire data at specific dates. ESA

N88-28462 Institut Francais du Petrole, Rueil-Malmaison.
SPOT: A SATELLITE FOR OCEANOGRAPHY
A. WADSWORTH and M. PETIT *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1087-1094 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Oceanographic data detectable by SPOT are shown. These include swell, internal waves, sea bed topography (through analysis of surface features), eddies, and hydrocarbon layers. The SPOT data are comparable to those of radar imagery from dedicated systems such as VARAN-S and Seasat. ESA

N88-28464 Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
CONTRIBUTION OF SPOT SATELLITE TO QUALITATIVE AND QUANTITATIVE MAPPING OF MARINE VEGETATION IN THE ENGLISH CHANNEL, NORTH ALTANTIC, WESTERN MEDITERRANEAN, AND SOUTH PACIFIC [APPORT DU SATELLITE SPOT A LA CARTOGRAPHIE QUALITATIVE ET QUANTITATIVE DES VEGETAUX MARINS DE LA MANCHE, DE L'ATLANTIQUE NORD, DE LA MEDITERRANEE OCCIDENTALE ET DU PACIFIQUE SUD]
THOMAS BELSHER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1105-1114 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Mapping of seaweed by SPOT satellite is reviewed. The use of SPOT satellite shows that the main problems of inventory, survey, of a standing crop of seaweed can be solved by high-resolution satellite data. ESA

N88-28465 Ecole Normale Superieure, Montrouge (France).
PHYSIOGRAPHY AND KINEMATICS OF THE WESTERN COAST OF THE PROVINCE OF HUELVA (ANDALOUSIA, SPAIN)
ERIC GUILLEMOT, LOIC MENANTEAU, YVES-FRANCOIS THOMAS, and REGINA ZBINDER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1115-1122 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Ground truth radiometric measurements of the different environments on the western coast of Huelva, especially salt-marshes, dunes and beaches, and SPOT imagery are compared. The great interest of satellite data in the study of the physiography and kinematics of this littoral area is shown. ESA

N88-28531# Naval Ocean Systems Center, San Diego, Calif.
IR (INFRARED) SKY RADIANCE DISTRIBUTIONS IN THE MARINE BOUNDARY LAYER Report, Apr. 1986
DAVID B. LAW and WILLIAM J. SCHADE Apr. 1988 13 p
(AD-A193683) Avail: NTIS HC A03/MF A01 CSCL 04A

Infrared optical properties of the marine boundary layer are basic in the performance of thermal imaging systems, such as forward looking infrared sensors, over the ocean. To aid in evaluating the performance of these sensors, spatial distributions of infrared sky radiance in the 3 to 5 micron mid-wavelength infrared and 8 to 12 micron long wavelength infrared spectral bands were measured simultaneously at low elevation angles above the sea surface. Calibrated AGA, Model 780, dual scanning systems functioned as imaging infrared radiometers. Radiosondes were released from at a range of 5 km due west of the coastal sensor site a Naval Ocean Systems Center, San Diego, Calif. Wind speed, direction, sea temperature, and cloud conditions were also recorded on board the ship. Sequential images of radiance distributions provided control data for monitoring the stability or variability of atmospheric conditions throughout the time for radiosonde ascent to about 6 km altitude. Measured IR sky radiance distributions were compared with corresponding clear sky radiance using the LOWTRAN 6 computer code. Cloud radiance and scattered solar radiation restricted the comparison to elevations close to the optical horizon where aerosol attenuation would be greatest. GRA

N88-28602# Naval Research Lab., Washington, D.C.
A PROBABILISTIC MODEL OF THE APPARENT RADIANCE OF A ROUGH SEA
R. G. PRIEST and I. B. SCHWARTZ 4 Mar. 1988 15 p
(AD-A193867; NRL-MR-6092) Avail: NTIS HC A03/MF A01 CSCL 08C

A widely used approach to the specification of the background statistics of wind driven sea states is the power spectral method. Coupled with a ray trace of the sky radiance, one can create deterministic images of a rough sea in the infrared. In this paper a probabilistic model of a rough sea is presented as an alternative to the power spectral approach. The model takes into account self-shadowing of the sea surface which is important when the sea is viewed at near grazing angles. Given such a model, the apparent radiance of a rough sea is shown to emit a substantially lower amount of radiation when compared to a smooth sea. The sea, being a poor emitter of radiation at near grazing angles, reflects cool sky radiation from higher points in the sky and therefore looks colder than its blackbody temperature. GRA

N88-29251# Naval Postgraduate School, Monterey, Calif.
METEOROLOGICAL FEATURES DURING THE MARGINAL ICE ZONE EXPERIMENT FROM 20 MARCH TO 10 APRIL 1987 M.S. Thesis
RYAN R. SCHULTZ Dec. 1987 86 p
(AD-A193960) Avail: NTIS HC A05/MF A01 CSCL 04B

Described are synoptic and mesoscale meteorological conditions which occurred in the marginal ice zone (MIZ) of the Greenland sea (Fram Strait). Measurements were made from three ships and weather analysis and ice edge location analysis were provided by shore meteorological support at Tromso, Norway. MIZEX 1987 is separated into five periods with distinct meteorological conditions. In the first period, from 20 to 23 March, the MIZ region was dominated by a large scale surface high pressure system. During the second period, from 24 to 27 March, a mesoscale boundary-layer front dominated the MIZ. This front was the object of a more detailed case study. During the third period, from 28 to 31 March, a weak surface synoptic-scale low pressure system dominated the MIZ. During the fourth period, from 1 to 3 April, a low developed 100 km east of Greenland and subsequently moved to the east, filling when it reached central Norway. During the fifth and final period, from 4 to 10 April, two lows developed 100 km north of Iceland which traveled northeastward along the classic secondary climatological storm track to a position 100 km southwest of the Svalbord Islands. When the first low of this fifth period stalled and was overtaken by the second low of this fifth period a combined and considerably enhanced system developed which extended along the west coast of the Svalbard Islands to the Norwegian Sea. All described features appeared clearly on NOAA 9 and 10 imagery. GRA

N88-29838# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
ERS-1: A SATELLITE WITH AN OCEANOGRAPHIC MISSION
R. W. VANSWOL Jul. 1986 17 p In DUTCH; ENGLISH summary Submitted for publication
(NLR-MP-86072-U; B8803806; ETN-88-92606) Avail: NTIS HC A03/MF A01

The ERS-1 program of ESA is outlined. The objectives of the ERS-1 mission and the satellite capabilities are summarized. The payload and orbit characteristics are described, including active microwave instrumentation, radar altimeter, along-track scanning radiometer/microwave sounder, precise range and range rate equipment, and laser retroreflectors. The ground segment and the concept chosen in order to meet the important requirement that data are to be delivered to the users within 3 hr are discussed. ESA

N88-30035# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.
MIZEX (MARGINAL ICE ZONE EXPERIMENT) 1987 SAR (SYNTHETIC APERTURE RADAR) DATA SUMMARY
R. A. SHUCHMAN, L. L. SUTHERLAND, and B. A. BURNS Feb. 1988 137 p
(Contract N00014-87-C-0418; N00014-81-C-0195)
(AD-A195560; ERIM-154600-34-T) Avail: NTIS HC A07/MF A01 CSCL 08L

The 1987 Winter MIZEX in the Greenland and Barents Seas, combined observation systems from both remote sensing and in situ data collection to provide an integrated approach to the study of winter marginal ice zone conditions. Favorable weather permitted 18 consecutive days of SAR coverage and field operations with real-time imagery downlinked to the ships in the field. Two INTERA SAR equipped aircraft were deployed to collect ice edge imagery. Throughout the experiment, real-time data was reviewed by scientists at Svalbard and on board the M/V POLAR CIRCLE. Observations made from this imagery enabled them to select areas of special interest for intensive study and sea truthing, and to plan successive SAR missions. Preliminary analysis indicates SAR imagery: (1) permits differentiation between first year ice, multi-year ice, and many stages of young ice; (2) can be used to detect surface expressions of eddies both in the open ocean and within the ice pack; (3) permits the tracking of ocean waves both outside and propagating approximately 100 km into the ice pack; (4) shows internal wave features beneath the ice pack; and (5) mapped an ocean polar front in the Barents Sea. GRA

N88-30036# Naval Research Lab., Washington, D.C.
MEASUREMENT AND INTERPRETATION OF NORTH ATLANTIC OCEAN MARINE RADAR SEA SCATTER Interim Report, Jan. 1985 - Jun. 1987
DENNIS B. TRIZNA 31 May 1988 54 p
(AD-A196239; NRL-9099) Avail: NTIS HC A04/MF A01 CSCL 17I

Results are presented for experiments conducted with a noncoherent, high-resolution marine navigation radar aboard the NOAA ship Researcher in the North Atlantic Ocean. High-resolution radar backscatter data were collected under wind-wave equilibrium conditions, i.e., both fetch and time requirements for fully developed seas were satisfied for the wind speeds reported. Cumulative distributions of normalized radar cross section (NRCS) of the sea surface are calculated and found to follow two Weibull distributions. Based on their characteristics, the distributions may be ascribed to two different scattering mechanisms: one due to scatterers evenly distributed over the surface, such as Bragg scatter; one due to localized scattering features, such as wave crests. The percentage occurrence of the localized scattering events (often called sea spikes) behaves with wind speed in a manner much like that found for whitecaps. Other characteristics of the two distributions also appear to correlate with wind speed, with a weak dependence on air-sea surface temperature difference. For very low grazing angles, many of these characteristics vary sharply near the 2 deg depression angle, which is a critical angle in several scattering models. An additional scattering model is proposed here to explain this behavior. GRA

N88-30167*# European Centre for Medium-Range Weather Forecasts, Reading (England).
A STUDY OF THE FEASIBILITY OF USING SEA AND WIND INFORMATION FROM THE ERS-1 SATELLITE. PART 1: WIND SCATTEROMETER DATA
D. ANDERSON, A. HOLLINGSWORTH, S. UPPALA, and P. WOICESHYN (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) Paris, France ESA Jun. 1987 127 p
(Contract ESRIN-6297/86-HGE-I(SC))
(NASA-CR-182833; NAS 1.26:182833; ESA-CR(P)-2604-PT-1; ETN-88-93033) Avail: NTIS HC A07/MF A01 CSCL 04A

The use of scatterometer and altimeter data in wind and wave assimilation, and the benefits this offers for quality assurance and validation of ERS-1 data were examined. Real time use of ERS-1 data was simulated through assimilation of Seasat scatterometer data. The potential for quality assurance and validation is demonstrated by documenting a series of substantial problems with the scatterometer data, which are known but took years to establish, or are new. A data impact study, and an analysis of the performance of ambiguity removal algorithms on real and simulated data were conducted. The impact of the data on analyses and forecasts is large in the Southern Hemisphere, generally small in the Northern Hemisphere, and occasionally large in the Tropics. Tests with simulated data give more optimistic results than tests with real data. Errors in ambiguity removal results occur in clusters. The probabilities which can be calculated for the ambiguous wind directions on ERS-1 contain more information than is given by a simple ranking of the directions. ESA

N88-30176# European Centre for Medium-Range Weather Forecasts, Reading (England).
A STUDY OF THE FEASIBILITY OF USING SEA AND WIND INFORMATION FROM THE ERS-1 SATELLITE. PART 2: USE OF SCATTEROMETER AND ALTIMETER DATA IN WAVE MODELING AND ASSIMILATION
PETER A. E. M. JANSSEN, PIERO LIONELLO (Consiglio Nazionale delle Ricerche, Venice, Italy), MAGNAR REISTAD, and ANTHONY HOLLINGSWORTH Paris, France ESA Jun. 1987 113 p
(Contract ESRIN-6297/86-HGE-I(SC))
(ESA-CR(P)-2604-PT-2; ETN-88-93034) Avail: NTIS HC A06/MF A01

A third generation wave-model and a global wave assimilation system were used to study the sensitivity of waves to scatterometer winds, and to simulate real time use of ERS-1 altimeter data through assimilation of Seasat altimeter data. The assimilation of altimeter wave data demonstrates the potential of a coupled real-time wind/wave assimilation for quality assurance and validation of scatterometer and altimeter data. The two-dimensional wave spectrum from a third-generation wave model can be used in interpretation and validation of the synthetic aperture radar image spectrum. ESA

N88-30525# Joint Publications Research Service, Arlington, Va.
EVOLUTION OF THERMAL STRUCTURE OF BENGUELA UPSWELLING SYSTEM ACCORDING TO SATELLITE AND SHIPBOARD DATA Abstract Only
A. S. KAZMIN, R. LEGECKIS, and K. N. FEDOROV *In its* JPRS Report: Science and Technology. USSR: Space p 22 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 3, May - Jun. 1987 p 26-37
Avail: NTIS HC A04/MF A01

Hydrophysical research was carried out in the Benguela upwelling region along the Namibian coast in April-June 1985 during the 14th cruise of the Prof. Shtokman. An analysis of shipboard and satellite data was made to determine the structure of ocean surface temperature (OST) and its evolution in the research area. The ship made six runs perpendicular to the coast with a minimum spacing of 15 miles. Infrared photos from the NOAA-NESS satellite were also used. It was possible to trace the full cycle of development of the hydrological situation, which included: a greatly transformed state of the system under conditions of prolonged absence of upwelling of fresh waters, a relatively brief phase of active upwelling associated with wind intensification, followed by relaxation until a new upwelling event occurs. During the observation period active upwelling processes were of moderate intensity, upwelling of waters occurred from realtively shallow depths and the coastal upwellings on the front were much less sharp than on fronts to the south. A study was made of the horizontal and vertical structure of a stationary large-scale anticyclonic eddy on the boundary of the cold coastal waters and its influence on the OST field. Author

N88-30534# Joint Publications Research Service, Arlington, Va.
KOSPAS-SARSAT SATELLITES USED FOR OCEAN CURRENT STUDY Abstract Only
YU. KOLESNIKOV *In its* JPRS Report: Science and Technology. USSR: Space p 26 26 Feb. 1988 Transl. into ENGLISH from Sotsialisticheskaya Industriya (Moscow, USSR), 2 Dec. 1987 p 4
Avail: NTIS HC A04/MF A01

KOSPAS-SARSAT satellites receive distress signals from special buoys. Scientists of the Ukrainian Academy of Sciences' Marine Hydrophysics Instsiute and the Lvov Polytechnical Institute thought: why not use these satellites to study ocean currents? They developed methods and equipment for a suitable experiment, which was conducted in the tropical zone of the Atlantic Ocean near the coasts of Surinam, Guyana and Brazil. The space rescue system ensured communication with the oceanologists' buoys for

as many as five to seven times a day. Whenever one of the satellites passed over these drifting radio transmitters, it registered its position. The spacecraft recorded this information in its memory and transmitted it to earth while flying over receiving stations. The information was then relayed to the laboratories of the oceanologists. Another advantage of the new method is that long searches for buoys after storm and fog will no longer be necessary. The equipment can be set adrift by practically any vessel whose route passes through a starting point designated by the scientists. Author

06

HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

A88-46767
LANDSAT - MSS RADIANCE AS A MEASURE OF SUSPENDED SEDIMENT IN THE LOWER YELLOW RIVER (HWANG HO)
S. ARANUVACHAPUN and D. E. WALLING (Exeter, University, England) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, July 1988, p. 145-165. refs
(Contract NERC-GR/3/5914)

A88-49234* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GLOBAL SURFACE-WATER-INDUCED SEASONAL VARIATIONS IN THE EARTH'S ROTATION AND GRAVITATIONAL FIELD
B. F. CHAO and WILLIAM P. O'CONNOR (NASA, Goddard Space Flight Center, Greenbelt, MD) Geophysical Journal (ISSN 0952-4592), vol. 94, Aug. 1988, p. 263-270. refs

The effects of seasonal changes in continental surface-water storage on the low-degree gravitational-field coefficients (J), the annual wobble excitation (Psi), and the seasonal length-of-day (LOD) variations are investigated by means of numerical simulations based on compiled meteorological data (Willmott et al., 1985) and satellite snow-load estimates (Chao et al., 1987). The formulation of the model equations and the overall characteristics of the data sets are discussed in detail, and the computation results are presented in tables and graphs. The effect on Psi is found to be relatively small due to longitudinal cancellation, but those on LOD and J are considered significant. T.K.

A88-49368
THE USE OF LANDSAT DATA FOR THE STUDY OF ALPINE GLACIERS - COMMENTS ON THE PAPER BY DELLA VENTURA ET AL. (1987)
HELMUT ROTT (Innsbruck, Universitaet, Austria) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1167-1169. refs

The method proposed by Della Ventura et al. (1987) for deriving various glacier features is shown to be insufficiently accurate for the investigation of Alpine glaciers. The spatial resolution of the sensor is too coarse for mapping the areas of small glaciers. Moreover, problems of shadowing, of discriminating snow and ice areas, and of identifying the glacier boundaries, have not properly been solved. Considering the size of the glaciers and the available information from other sources, the main application of satellite sensor imagery to glaciological studies in the Alps is monitoring the extent of snow and ice areas on glaciers. In other mountain regions Landsat MSS and TM imagery is an important data source for deriving base maps on glacier extent. Author

A88-49369
FURTHER COMMENTS ON 'THE DEVELOPMENT OF A SATELLITE REMOTE SENSING TECHNIQUE FOR THE STUDY OF ALPINE GLACIERS'
ANNA DELLA VENTURA, ANNA RAMPINI (CNR, Istituto di Fisica Cosmica e Tecnologie Relative, Milan, Italy), RICCARDO RABAGLIATI (IBM Italia S.p.A., Mestre, Italy), and ROSSANA SERANDREI BARBERO (CNR, Istituto per lo Studio della Dinamica delle Grandi Masse, Venice, Italy) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1171-1174. refs

The main purpose of this letter is to reply to the comments of Rott (1988) on the paper of Della Ventura et al. (1987). Rott's criticism of the method proposed there is based on three points: the computed area values, the extent of glacier fluctuations, and the difference between the declared objectives and the results. This letter therefore reiterates the aims and basic techniques presented in the previous paper, albeit employing a more didactic approach. The method and results advanced by Rott are also discussed. Author

A88-52429*# National Air and Space Museum, Washington, D.C.
THE INTERACTION OF WIND AND WATER IN THE DESERTIFICATION ENVIRONMENT
P. A. JACOBBERGER (National Air and Space Museum, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 87-94. Research supported by Smithson Society. refs
(Contract NAS5-28774)

An appropriate process/response model for the physical basis of desertification is provided by the interactions of wind and water in the desert fringe environment. Essentially, the process of desertification can be thought of as a progressive environmental transition from predominantly fluvial to aeolian processes. This is a simple but useful way of looking at desertification; in this context, desertification is morphogenetic in character. To illustrate the model, a study of drought-related changes in central Mali will serve to trace the interrelated responses of geomorphologic processes to drought conditions. Author

A88-52438#
CASE HISTORIES OF GROUND WATER EXPLORATION SUCCESSES IN ARID AND SEMI-ARID REGIONS
ALLEN M. FEDER (Western Geophysical Company of America, Aero Service Div., Houston, TX) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 201-219. refs

Remote sensing examples and advantages in ground water exploration are introduced. Case histories are discussed in conjunction with individual remote sensor (system) performances. These are, in turn, arbitrarily sequenced according to the electromagnetic spectrum wavelength involved, and then potential field. The sequence leads to a combined grouping of satellite and space shuttle sensing technology in the predominantly visible spectrum region. This technology, and that of synthetic aperture radar (SAR), comprise the synoptic, areal reconnaissance foundation for follow-up, detail work using the other remote sensing techniques of gamma-ray spectrometry, far (8-14 micrometer) infrared, and aeromagnetometry. Finally two, computer-based, remote sensor data processing systems for ground water exploration activities are described. Author

A88-52439#
APPLICATION OF REMOTE SENSING FOR GROUNDWATER SURVEY IN KENYA
G. J. KROL (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands), J. L. J. DE SONNEVILLE, and L. VASAK (Centrale Organisatie voor Toegepast-Natuur-wetenschappelijk Onderzoek, Delft, Netherlands) IN: International

Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 221-234. refs

A method of remote sensing application for a step-by-step groundwater survey is presented. Landsat images and aerial photographs are interpreted for two areas: one which has been widely studied previously, and one which has been studied very little. The method involves inventory, remote sensing techniques, field techniques, and exploratory drilling. It is found that satellite images are most useful for obtaining extra information on vegetation and drainage for areas with little information. It is shown that aerial photographs in hard rock areas are effective in locating potential drilling sites, although fieldwork and exploratory drilling are generally necessary in nonindurated formations. R.B.

A88-52440#
ESTIMATION OF PRECIPITATION FROM AVHRR AND METEOSTAT DATA OVER AFRICA
E. C. BARRETT (Bristol, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 235-254. refs

In response to the often inadequate supply of raingauge data, and the growing appreciation that meteorological satellite data may usefully complement ground truth measurements of rainfall, an ever-widening range of satellite rainfall estimation techniques is being developed. This range of techniques is summarized, and then exemplified by reference to methods which members of the Remote Sensing Unit of the University of Bristol, U.K., have devised and/or helped to develop. Operational strategies for the routine implementation of selected, or even customized, techniques are discussed. Finally, a number of requirements for future progress is listed. Author

A88-52442#
SWAMPS AND DAMBOS IN AFRICAN HYDROLOGIC REGIMES
J. MAWUSE DAKE (African Development Experts, Accra, Ghana) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 259-268. refs

The paper seeks to place tropical swamps and dambos in their proper place in the hydrologic regimes of African water basins. It identifies the absence of reliable scientific data as the main constraint in the classification of swamps and a realistic assessment of their role in water balance calculations. It visualizes a significant role for remote sensing applications in enhancing understanding of the African swamps and ensuring that their ultimate development and exploitation do not lead to irreparable ecological damage. Author

A88-52460#
THE USE OF METEOSAT DATA TO EVALUATE RAINFALL IN TROPICAL AFRICA
G. DUGDALE and J. R. MILFORD (Reading, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 499-506. Research supported by the UK Overseas Development Administration, United Nations, and EEC.

A study using Meteosat data to obtain quantitative information on rainfall in tropical Africa is presented. The study, which focused on the area of Niger, assessed area rainfall using thermal-IR data to infer the presence of cumulonimbus clouds and squall lines. Satellite observations were used to calculate thermal inertia and soil moisture. The data for the study included Meteosat data averaging 20 slots/day at full resolution, climatological data for the region, rainfall data for western Africa, and soil moisture measured weekly and soil temperatures measured three times a day at nine test sites. Results of rainfall measurements and variability are presented and illustrated. R.B.

A88-52471#
INTEGRATION OF REMOTE SENSING DATA INTO AN INFORMATION SYSTEM
A. DELLA VENTURA, A. RAMPINI (CNR, Istituto per Ricerche in Fisica Cosmica e Tecnologie Relative, Milan, Italy), R. RABAGLIATI (IBM Italia S.p.A., Venice, Italy), G. ROSSI (ENEL, Servizio Idrologico, Venice, Italy), and R. SERANDREI BARBERO (CNR, Istituto per lo Studio della Dinamica delle Grandi Masse, Venice, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 669-676. refs

The development of a digital terrain model and a snowmelt-runoff model is examined to prvoide examples of the way in which a model information system can be integrated with data obtained through remote sensing. The inputs of the mathematicl snowmelt model are based on daily precipitation data, daily temperature values, and periodic snowpack depth and density measurements has been developed. The digital terrain model was built from 1:25,000 scale maps. A diagram of the snowmelt model is presented and the frequency of pixels versus elevation and snow depth is presented graphically. The process of map classification is examined. It is concluded that although the models are based on satellite data, real-time inputs are necessary for the models to be useful. R.B.

A88-52472#
INTEGRATING LANDSAT MSS SATELLITE AND CONVENTIONAL GEOMORPHOLOGIC DATA TO DEFINE A HYDRO-ECOLOGICAL ZONING OF THE UPPER NIGER BASIN
HANS G. KOHL (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 699-703.

A88-52476#
HYDROLOGIC MODELING USING REMOTE SENSING GEOGRAPHIC INFORMATION SYSTEMS AND THE FINITE ELEMENT METHOD
BAXTER E. VIEUX (USDA, Soil Conservation Service, East Lansing, MI), VINCENT F. BRALTS, and KYLE KITTLESON (Michigan State University, East Lansing) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 731-742. refs

Two technologies have evolved which if integrated could provide superior hydrologic modeling. These technologies are Geographic Information Systems and the Finite Element Method. Together, a powerful hydrologic model results. Geogrphic Information Systems (GIS) are used to process a watershed into hydrologically homogeneous subareas. The subareas become the geometric shapes or finite elements over which the equations of overland flow are solved. By utilizing the efficiency of the GIS to process natural resource data, the finite element method for overland flow is easily applied to watersheds composed of diverse soils, topography, and landuse. The ease of watershed assessment enhances the ability of decision makers to assess impacts of landuse changes, and to define location and severity of agricultural nonpoint source pollution and other hydrologic related concerns. Author

A88-52490#
SATELLITE CLOUD AND RAINFALL ASSESSMENT IN THE WESTERN SAHEL
E. C. BARRETT and C. H. POWER (Bristol, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 943-954. NOAA-ESA-EEC-supported research. refs

The use of Meteosat imagery for cloud cover and rainfall monitoring in the western Sahel is examined. Daily Meteosat-2 IR images using four time slots of full resolution are used to

differentiate between high, middle, and low clouds, and no cloud areas. The cloud cover maps and statistics are transformed into rainfall and a satellite-improved rainfall monitoring technique is presented. Examples of different aspects of cloud cover and rainfall monitoring are presented for the period of July 1985. R.B.

A88-52491#
ADMIT - AN OBJECTIVE TECHNIQUE FOR BROAD-SCALE RAINFALL MONITORING BY GEOSTATIONARY SATELLITES
E. C. BARRETT and G. D'SOUZA (Bristol, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 955-964. refs

The ADMIT method (Agricultural Drought Monitoring Integrative Technique) for rainfall estimation using visible and infrared imagery from Meteosat 2 is described. Results and products obtained from the successful application of the technique are presented for the whole of Africa at quarter resolution for January and July 1985, and then to part of the Western Sahel at full resolution, with tailored parameters for July 1985. Author

A88-52493#
AEROSPACE IMAGERY AND GEO-INFORMATION SYSTEMS FOR WATERSHED MANAGEMENT
C. R. VALENZUELA, A. M. J. MEIJERINK, and J. HUISING (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 975-983. refs

The development of an integrated land and watershed information system (ILWIS) consisting of an information system and a modeling system to assist in development and conservation activities is discussed. The system integrates map and satellite data to create digital terrain modules. The terrain, soil geography, cover, water, and socioeconomic modules are examined. The methods of data manipulation are presented and an example using the method in a hydrology-erosion model is given. R.B.

A88-52494#
ASSESSMENT OF THE EFFECT OF AFRICAN DROUGHT ON WATER RESOURCE MANAGEMENT IN EGYPT USING REMOTELY-SENSED DATA
SCOT E. SMITH (Ohio State University, Columbus) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 985-991. refs

The use of Landsat imagery to determine the effect of drought on Egyptian water resources is presented. The drought, Nile hydrology, and impoundment projects on the Nile are examined. The satellite imagery was used to measure the surface area of the Aswan Reservoir in order to calculate evaporation. The results of these calculations are given and programs for water conservation are discussed. R.B.

A88-52495#
WATER BALANCE MONITORING IN SAHELIAN REGIONS WITH THERMAL IR AND VEGETATION INDEX DATA FROM METEOROLOGICAL SATELLITES
B. SEGUIN, J. P. LAGOUARDE (Institut National de la Recherche Agronomique, Montfavet, France), E. ASSAD, J. P. FRETEAUD (Institut de Recherches Agronomiques Tropicales, Saint-Gely-du-Fesc, France), and Y. KERR (CNES, Laboratoire d'Etudes et de Recherches en Teledetection Spatiale, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 993-1003. Research supported by the Ministere des Relations Exterieures. refs
(Contract EURATOM-2404-84-07-ED; EEC-DG8A2)

A88-52496#
ESTIMATION OF CHANGING SURFACE SOIL MOISTURE DISTRIBUTION IN ARID AREA BY NOAA AVHRR
MASUYOSHI MATSUDA (MTS Institute, Inc., Tokyo, Japan) and KATSUTOSHI KOZAI (Kobe University of Mercantile Marine, Japan) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1005-1014.

A88-52497#
PROBLEMS IN THE USE OF REMOTELY SENSED GEOLOGIC LINEAR FEATURES FOR THE LOCATION OF GROUNDWATER ABSTRACTION SITES - A CASE STUDY FROM THE MENDIP HILLS, SOUTHWEST ENGLAND
PAULINE A. WATERS, PETER L. SMART, and HENRY A. OSMASTON (Bristol, University, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1015-1024. refs

A88-52498#
DETECTION OF HYDROLOGICAL INDICATORS FOR THE WATER-FLOW AVAILABILITY PREVISION IN THE SENEGAL RIVER BASIN
P. A. BRIVIO and E. ZILIOLI (CNR, Istituto per la Geofisica della Litosfera, Milan, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1025-1033. Research supported by the Direction Nationale de la Meteorologie of Guinea. refs

A88-52499#
THE APPLICATION OF REMOTE SENSING TO ANNUAL PRECIPITATION-RUNOFF RELATIONSHIPS FOR THE SUDANO-SAHELIAN ZONE OF WEST AFRICA
A. PIETRONIRO and S. I. SOLOMON (Waterloo, University, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1035-1044. refs

A88-52501#
EURECA-BORNE INSTRUMENT FOR REMOTE SENSING OF HIGH-RESOLUTION WATER VAPOR FIELDS
CARLO ULIVIERI (Roma I, Universita, Rome, Italy), VITO FRANCESCO POLCARO (CNR, Istituto di Astrofisica Spaziale, Frascati, Italy), and CARLO CARNEBIANCA (Italspazio Consorzio Industriale, Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1051-1058. refs

The possibility of determining the atmospheric total water vapor content from simultaneous measurements in three thermal infrared channels between 10 and 13 micrometers has been explored and a fast algorithm for estimating the low-level precipitable water in clear air from multi-split window measurements has been found. The mission feasibility at low orbit has been explored to benefit of the flight opportunities offered by Eureca platform. Author

A88-52509#
DESERTIFICATION IN QATAR PENINSULA - A CASE STUDY
MAHMOUD M. ASHOUR and IBRAHIM A. EL KASSAS (University of Qatar, Doha) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1129-1141. refs

The desertification process in the Qatar Peninsular is examined, noting the features resulting form the process which can be spotted with aerial photograpy. The distribution, development, and use of arable land in the region are considered. Aspects of the desertification process discussed, include the depletion of

groundwater, the deterioration of cultivable soils, the encroachment of eolian sands, and anthropogenous processes. It is concluded that remote sensing techniques can be used to detect and monitor the features caused by desertification. R.B.

A88-52512#
EXTRACTION OF HYDROLOGICAL PARAMETERS FROM LANDSAT THEMATIC MAPPER IMAGERY
MARTIN J. FRANCE, W. GORDON COLLINS, and THOMAS R. E. CHIDLEY (Aston University, Birmingham, England) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1165-1173. refs

The accuracy of Landsat TM imagery in delineating, mapping, and measuring hydrological data is evaluated. Landsat MSS imagery, 1:50,000 scale panchromatic aerial photography, and a 1:50,000 scale base map are compared for an area of the UK. The effect of increased spatial and spectral resolution of Landsat TM with respect to Landsat MSS in identifying drainage networks and landcover types is examined. Surface water detection, stream length, drainage density, stream-width, and stream order from each data type are compared with ground truth data for the area. The differences between automatic landcover classification and visually interpreted landcover details are considered. The use of Landsat TM data in hydrological models is discussed and a cost comparison of various systems is given. R.B.

A88-52513#
APPLICATION OF LANDSAT MSS DATA TO THE LOCATION OF POTENTIAL GROUNDWATER IN THE ADAMAWA PLATEAU OF CENTRAL CAMEROON
ESTELLA MKWATE, BALARAM DEY, and V. K. SHARMA (Howard University, Washington, DC) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1175-1180. refs

A88-52516#
REMOTE SENSING SYSTEMS CONTRIBUTION TO THE RESOLUTION OF WATER RESEARCH PROBLEMS IN THE SAHARIAN REGION OF ADRAR DES IFORAS
V. CHIARINI, S. D'ANGELO, G. L. DEL BONO, and A. PANTALEONE (Geological Survey of Italy, Rome) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1201-1209.

A88-52529#
CHANGE DETECTION IN REMOTE SENSING - THE SEQUENTIAL SIMILARITY DETECTION ALGORITHMS
A. N. NASR, F. H. SALEH, S. I. SHAHEEN, and M. A. ABDEL HADY (Academy of Scientific Research and Technology; Cairo University, Egypt) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1339-1351. refs

The development of software based on computer aided analysis of Landsat MSS data to be used in change detection is discussed. The study was conducted to produce programs for the registration of multitemporal images. Changes were examined in the coastal region along the Nile Delta for the period January 1973-June 1976 and in the Lake Nasser reservoir for November 1972-June 1975. The Landsat MSS images of the areas and the results of applying the software to detect changes in the areas are presented. R.B.

A88-52542#
THE REMOTE SENSING STUDY OF RECENT DYNAMIC CHANGES OF HUANGHE RIVER DELTA COAST
ZHAUMU FAN (Research Institute of Petroleum, Beijing, People's Republic of China) and XIA LI (Guangzhou Institute of Geography, People's Republic of China) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1457-1463. refs

A88-53529
USE OF SPOT HRV DATA IN THE CORPS OF ENGINEERS DREDGING PROGRAM
CAROLYN J. MERRY, HARLAN L. MCKIM, NANCY LAPOTIN (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), and JOHN R. ADAMS (U.S. Army, Engineer District, Buffalo, NY) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Sept. 1988, p. 1295-1299. Army-supported research. refs

The Corps of Engineers coordinated a water quality sampling program with a dredged material disposal operation and a concurrent SPOT overpass on June 4, 1986. The SPOT HRV 20-m multispectral data were classified into five water categories using a maximum likelihood classifier. A post-classification filter was used to smooth the water. Due to the limited amount of ground truth data, simple empirical models are presented to illustrate the association between turbidity and spectral class. Author

A88-55023* Cornell Univ., Ithaca, N.Y.
LARGE-SCALE EXPERIMENTAL TECHNOLOGY WITH REMOTE SENSING IN LAND SURFACE HYDROLOGY AND METEOROLOGY
WILFRIED BRUTSAERT (Cornell University, Ithaca, NY), THOMAS J. SCHMUGGE (USDA, Agricultural Research Service Hydrology Laboratory, Beltsville, MD), PIERS J. SELLERS (Maryland, University, College Park), and FORREST G. HALL (NASA, Goddard Space Flight Center, Greenbelt, MD) EOS (ISSN 0096-3941), vol. 69, May 3, 1988, p. 561, 569-571. refs
(Contract NSF ATM-86-01115; NSF ATM-86-19193; NAG5-492; NAG5-907)

Two field experiments to study atmospheric and land surface processes and their interactions are summarized. The Hydrologic-Atmospheric Pilot Experiment, which tested techniques for measuring evaporation, soil moisture storage, and runoff at scales of about 100 km, was conducted over a 100 X 100 km area in France from mid-1985 to early 1987. The first International Satellite Land Surface Climatology Program field experiment was conducted in 1987 to develop and use relationships between current satellite measurements and hydrologic, climatic, and biophysical variables at the earth's surface and to validate these relationships with ground truth. This experiment also validated surface parameterization methods for simulation models that describe surface processes from the scale of vegetation leaves up to scales appropriate to satellite remote sensing. R.B.

N88-25950# Universidade Estudual de Paulista, Rio Claro (Brazil).
USE OF REMOTE SENSING IN THE STUDY OF SUPERFICIAL FORMATION CERTIFYING THE DEVELOPMENT OF INTEGRATED ECONOMY-CASE EXAMPLE: RIO CLARO (SP) REGION
PAULINA SETTIRIEDEL, JUERCIO TAVARESDEMATTOS, and JAIRO ROBERTO JIMENEZRUEDA *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 144-150 1987
Avail: NTIS HC A14/MF A01

The present work proposes a methodology for systematic interpretation of remote sensing data for the mapping of superficial formation of the Rio Claro (SP) region, as an aid, in the organization of physical resources. The method utilized includes the analysis of textural elements of raised structures, and drainage certifying the shape characteristics of these properties. Author

N88-25955# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
AERIAL PHOTOGRAPHY AS AN INSTRUMENT OF ATMOSPHERIC ANALYSIS: MAPS OF THE MIDDLE ATMOSPHERE AND ITS DYNAMICS, BAIXADA SANTISTA (SP)

FREDERICO HERMAN, JR. *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning p 211-231 1987
Avail: NTIS HC A14/MF A01

Topics addressed include: mapping of the middle atmosphere and its methodology; use of aerial photographs; toponymy and topography; hydrography and hydrology; climatic conditions; cultivation; surface degradation; water pollution; and air pollution. B.G.

N88-26064# Observatoire de Paris-Meudon (France).
STUDY OF THE ARACHON (FRANCE) UNDERWATER DELTA USING THEMATIC MAPPER DATA [ETUDE DU DELTA SOUS-MARIN D'ARCACHON D'APRES DES DONNEES DU THEMATIC MAPPER]
DONG CHEN HE, J. LERHUN, and LI WANG *In* ESA, Proceedings of the Colloquium on Space and Sea p 339-343 Mar. 1988 In FRENCH; ENGLISH summary
Avail: NTIS HC A15/MF A01

The passes of the Arcachon Basin (France) which are affected by unpredictable spatial instabilities were analyzed. Using the dynamic-cluster algorithm, the site was studied with a classification of a LANDSAT-5 TM image acquired 2 h 20 min after high tide. The classification result shows clearly the exterior contour of the submarine delta. The south channel, where the flood predominates, and the north channel, where the ebb predominates, are well characterized. The cross-channel appears shallow and not very marked. Although underwater, the sandy banks are well seen in the classification map. This cartography shows that satellite data are a precious tool for dynamic studies of the littoral and submarine sedimentations. ESA

N88-26712*# Oklahoma Univ., Norman. School of Meteorology.
HYDROLOGIC MODELS FOR LAND-ATMOSPHERE RETROSPECTIVE STUDIES OF THE USE OF LANDSAT AND AVHRR DATA Semiannual Report, 1 Oct. 1987 - 31 Mar. 1988
CLAUDE E. DUCHON, T. H. LEE WILLIAMS, and ARLIN D. NICKS 2 Jun. 1988 2 p Sponsored by NASA
(NASA-CR-182861; NAS 1.26:182861) Avail: NTIS HC A02/MF A01 CSCL 08B

The use of a Geographic Information System (GIS) and LANDSAT analysis in conjunction with the Simulator for Water Resources on a Rural Basin (SWRRB) hydrologic model to examine the water balance on the Little Washita River basin is discussed. LANDSAT analysis was used to divide the basin into eight non-contiguous land covers or subareas: rangeland, grazed range, winter wheat, alfalfa/pasture, bare soil, water, woodland, and impervious land (roads, quarry). The use of a geographic information system allowed for the calculation of SWRRB model parameters in each subarea. Four data sets were constructed in order to compare SWRRB estimates of hydrologic processes using two methods of maximum LAI and two methods of watershed subdivision. Maximum LAI was determined from a continental scale map, which provided a value of 4.5 for the entire basin, and from its association with the type of land-cover (eight values). The two methods of watershed subdivision were determined according to drainage subbasin (four) and the eight land-covers. These data sets were used with the SWRRB model to obtain daily hydrologic estimates for 1985. The results of the one year analysis lead to the conclusion that the greater homogeneity of a land-cover subdivision provides better water yield estimates than those based on a drainage properties subdivision. B.G.

N88-26715# Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
SURFACE HYDROLOGY, SEDIMENT TRANSPORT DYNAMICS AND REMOTE SENSING OF DISTURBED WATERSHEDS IN A HUMID TEMPERATE REGION Progress Report
1988 6 p
(Contract DE-FG02-87ER-60594)
(DE88-008719; DOE/ER-60594/1) Avail: NTIS HC A02/MF A01

The fundamental goal of this multilayer research effort is to quantify the temporal evolution of the hydrologic cycle on disturbed watersheds and construct a modular hydrologic model that uses, as primary input, variable quantities and types of remotely sensed data sets in a Geographic Information System (GIS) format. The hypothesis to be tested states that the geomorphic evolution of disturbed watersheds which are in disequilibrium can be quantified with field data and subsequently modeled, utilizing both field-derived and remotely sensed data sets. DOE

N88-26716*# Oklahoma Univ., Norman. School of Meteorology.
HYDROLOGIC MODELS FOR LAND-ATMOSPHERE RETROSPECTIVE STUDIES OF THE USE OF LANDSAT AND AVHRR DATA Semiannual Report, 1 Oct. 1987 - 31 Mar. 1988
CLAUDE E. DUCHON, T. H. LEE WILLIAMS, and ARLIN D. NICKS 2 Jun. 1988 2 p Sponsored by NASA
(NASA-CR-182862; NAS 1.26:182862) Avail: NTIS HC A02/MF A01 CSCL 04A

The use of a Geographic Information System (GIS) and LANDSAT analysis in conjunction with the Simulator for Water Resources on a Rural Basin (SWRRB) hydrologic model to examine the water balance on the Little Washita River basin is discussed. In the research completed to date LANDSAT analysis was used to divide the basin into eight non-contiguous land covers or sub areas. The use of a geographic informatin system allowed for the calculation of SWRRB model parameters in each subarea. Four data sets were constructed in order to compare SWRRB estimates of hydrologic processes using two methods of maximum LAI and two methods of watershed division. These data sets were used with the SWRRB model to obtain daily hydrologic estimates for 1985. B.G.

N88-27616# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
IEMIS (INTEGRATED EMERGENCY MANAGEMENT INFORMATION SYSTEM) FLOODPLAIN MAPPING BASED ON A LIDAR DERIVED DATA SET Final Report
JACK K. STOLL, DALE A. LEHMAN, and DANIEL M. COTTER 5 Feb. 1988 22 p
(AD-A193071) Avail: NTIS HC A03/MF A01 CSCL 08B

The LIDAR demonstration project has shown that ground elevation data required by FIA for FISs can be collected digitally, and rapidly, through the application of laser ranging technology. LIDAR technology offers some clear advantages in flexibility, speed, and data quantity over conventional surveying. Laser ranging technology is mature and precise; however, the ability to maintain aircraft position control at all times within accuracy limits that allow LIDAR data to be applied to FISs remains a challenge. The analysis of the test data indicates that, with due care and planning, this objective can be achieved. IEMIS, with GIS, modeling, and networking capabilities, can be used to automate the revision, update, and analysis of flood hazard maps produced by FIA. The major constraint to the development of digital floodplain analyses is the lack of digital topographic data. Through application of FAST software, WES has demonstrated that digital LIDAR can make the automation of flood hazard analysis and mapping, and the exploitation of IEMIS for NFIP applications, feasible. GRA

N88-27618# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
REMOTE SENSING OF WETLANDS: APPLICATIONS OVERVIEW
H. E. MACKEY, JR. and J. R. JENSEN 1988 3 p Presented at the 1st Special Workshop on Videography, Terre Haute, Ind., 19 May 1988 Prepared in cooperation with South Carolina Univ., Columbia
(Contract DE-AC09-76SR-00001)
(DE88-010895; DP-MS-88-87; CONF-8805118-1) Avail: NTIS HC A02/MF A01

Wetlands, unlike many upland plant community types, present various challenges to effective evaluation and quantification. Wetlands cover a wide range from small tributary streams to shrub/scrub and marsh communities to open water lacustrine environment. Thus, the heterogeneity of species composition and

spacial distribution of wetlands can present a formidable challenge for evalaution with remote sensing techniques. In addition, wetlands can change dramatically seasonally, especially with the development of non-persistent species. Various types of remote sensing data have been used to map and characterize wetlands. Regionally LANDSAT MSS and TM satellite data have been used for wetland mapping by various government agencies and private organizations, such as Ducks Unlimited. In addition, multispectral SPOT data are becoming available and provide opportunities for increased spatial resolution and frequency of coverage. DOE

N88-28348 Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Paris (France).
MAPPING OF STREAMFLOW AND SOIL INFILTRATION OF A SAHELIAN CATCHMENT AREA BY SPOT IMAGE INTERPRETATION: THE OURSI POND CATCHMENT AREA IN BURKINO FASO [CARTOGRAPHIE DES APTITUDES AU RUISSELLEMENT ET A L'INFILTRATION DES SOLS D'UN BASSIN VERSANT SAHELIEN PAR INTERPRETATION DES IMAGES SPOT: LE BASSIN VERSANT DE LA MARE D'OURSI, BURKINA FASO]
J. M. LAMACHERE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 41-51 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A method for streamflow measurement utilization for areas less than 1 sqm using a rain simulator and interpretation of SPOT satellite imagery was developed. Although the test area consists of homogeneous surfaces smaller in extent than a pixel in the SPOT image, image analysis allows zones which are radiometrically identical to be mapped. These zones contain only a few surface types and ground observations enable hydrodynamic relationships to be established. From these, areas of likely streamflow and ground infiltration can be mapped. The maps can serve as input to a model of the flow in the catchment area, along with data on hydrography and basin size and shape. ESA

N88-28349 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
THE USE OF SPOT IMAGES FOR WATER RESOURCES SURVEYS IN THE KASSERINE BASIN (TUNISIA)
DIRK DEHOOP *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 53-58 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The use of SPOT imagery in hydrogeological surveys of an area with surface runoff and ground water resources was assessed. It is shown that SPOT data can be used for detailed water resources surveys as a useful tool together with advanced classical hydrogeological exploration methods. The greatest benefit is obtained by using SPOT in conjunction with other data sets. Under such conditions the most efficient and cost-effective mode of exploration is a multistage approach, starting with a reconnaissance survey with SPOT images and limited fieldwork, followed by airphoto interpretation of selected areas. The main advantages of SPOT are its high spatial resolution and stereo capability. ESA

N88-28350 Grenoble Univ. (France). Lab. d'Amenagement de la Montagne Alpine.
SPOT IMAGE EXPLOITATION FOR GLACIAL MASS BALANCE FLUCTUATION MONITORING IN THE FRENCH ALPS
J. P. DEDIEU and L. REYNAUD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 59-68 1988 In FRENCH; ENGLISH summary Original contains original illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT imagery to complete ground data on glacial fluctuation and mass balance by delimiting the dividing line between ice and snow areas is proposed. The measurements require the use of specific ratios in the visible and infrared spectral bands. A test in the French Alps to confirm usefulness for remote ice zone surveys is proposed. An image processing method which takes into account topography effects and the radiative properties of snow and ice is outlined. ESA

N88-28351 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
SPOT ON LAND AND LAKES IN THE HUBEI PROVINCE (CHINA)
T. WOLDAI, YAN KAI, S. A. HEMPENIUS, E. B. VERMEER, SHU NING (Wuhan Technical Univ. of Surveying and Mapping, China), and R. A. KNIPPERS *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 69-80 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Four SPOT frames (in XS and P mode) were analyzed for a semi-detailed reconnaissance study of land and lakes in the Wuhan area, Hubei Province, China. The area was previously studied by using LANDSAT MSS data. Groundcheck and data collection was also done, but aerial photographs are not easily available, so SPOT is used to fill this gap and changes in flood control and land reclamation were analyzed. Enhancement techniques (especially with the SPOT-P data) allow the identification of land use units in the urban area. The comparison of LANDSAT MSS and SPOT images clearly illustrates the limitation of MSS data and how the 10 and 20m resolutions greatly improve the definition of individual fields. Analysis on a field-by-field basis is impractical using MSS data. ESA

N88-28353 Aerial Mapping and Photography Ltd., Saint John's (Newfoundland).
AN EVALUATION OF SPOT IMAGERY FOR WETLAND MONITORING
H. T. RIPLEY and J. P. A. MAWDSLEY (Eastern Interpretative Services, Saint John's, Newfoundland) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 93-97 1988 Sponsored by the Newfoundland Department of Development, Canada and the Canadian National Research Council
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It was intended that SPOT imagery would be evaluated for its potential use in wetland monitoring programs. The study site chosen was a combination of fresh and salt water marshes and agricultural lands. The study was not completed due to not receiving the satellite data requested. Despite this, useful lessons were learned, particularly on the need for multidate data and field work closely synchronized with satellite passes. ESA

N88-28357 Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).
USE OF SPOT SATELLITE IN AGROHYDROLOGY: DETECTION OF SPRING WATER EXCESS IN A GRASSLAND REGION
J.-L. LEJEUNE, A. MOKADEM, and S. DAUTREBANDE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 121-128 1988 In FRENCH; ENGLISH summary Sponsored by the Belgian Service de la Programmation de la Politique Scientifique Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The relation between spectral response and excesses of water in springtime was studied using SPOT images of an area in Belgium characterized by great differences in the hydrology of the soil in a small zone. Analysis of SPOT images shows highly significant differences between the spectral signatures of well drained and artificially drained grassland and badly drained areas. On the ground, there is no difference between the flora of these regions, but rather between their vigor and growth rates. Two methods were used to quantify relations between ground parameters and satellite data: digitizing which produces a percentage estimate of zones well classified; and comparison of ground data and supervised classification of images, which evaluates the number of correctly classed pixels. Results show that the state of pastures

at the start of the growing season, expressed in terms of near IR reflectance, is a good indicator of general grassland quality, in relation to soil depth and hydromorphology for the test region. ESA

N88-28367 Pennsylvania State Univ., University Park.
DELINEATION OF EPHEMERAL FLUVIAL NETWORKS ON LOW-RELIEF PIEDMONT SURFACES, PLUTONIUM VALLEY, NEVADA, USA
THOMAS W. GARDNER, KATHRYN F. CONNORS, HAIYAN HU, and GARY W. PETERSEN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 215-220 1988
(Contract DE-FG02-86ER60472)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT panchromatic band data are used to delineate fluvial networks on low-relief piedmont surfaces in an arid basin in the southwestern U.S. The SPOT classified map is compared to a Strahler-order stream network extracted from 7 1/2 minute topographic maps. An 8-connected thinning algorithm is used to produce a 1-pixel wide channel network from the classified SPOT image. The high albedo contrast between fan surface and active channel provides for stream classification with the high resolution SPOT panchromatic band. The SPOT panchromatic band can detect small (less than 2m wide, first order turbulences). Classification techniques correctly identify 76 percent of the 2nd order and larger streams and 3rd order and larger streams, and 98 percent of the 4th order and larger stream channels. The panchromatic band delineates many of the channels visible on 1959 black and white aerial photographs, but too insignificant to be mapped as blue line streams on the 7 1/2 minute topographic maps. Yet in hydrologic modeling of small basins, these unmarked channels may be important. It is apparent that SPOT panchromatic data could be used to map fluvial networks in similar areas without topographic maps or to update existing maps. ESA

N88-28421 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
KARST AND SUBMARINE FRESH WATER DISCHARGE IN THE ANTALYA AREA, SOUTHERN TURKEY
JAN J. NOSSIN, ATILA SESOREN, and IBRAHIM HAKIM KURAN (State Waterworks of Turkey, Ankara.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 719-729 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Interpretability of surface karst geomorphological features in stereoscopic SPOT imagery; and detectability of undersea discharge of karst water were studied. The area studied lies near Antalya in southern Turkey, and was chosen for its karst characteristics and for the existence of considerable ground truth. Results show the utility of SPOT for these studies and the possibilities of using the images for other purposes, e.g., environment protection. ESA

N88-28435 International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
COMPARING DIFFERENT IMAGES FOR GROUND WATER SURVEY BASED ON LINEAMENT ANALYSIS
D. F. KOVACS and G. J. KROL *In* CNES, SPOT 1 Image Utilization, Assessment, Results, p 845-850 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A computer aided lineament analysis, supported by fieldwork and maps compiled from SPOT and LANDSAT imagery and aerial photography, was used to survey ground water in the lower Rio Tormes basin (Spain). For local and detailed investigations serial photo interpretation is preferable. A large number of satellite lineaments less than 3 km can be extracted, while on the satellite images these cannot be observed easily. The Thematic Mapper band 7, enlarged to scale 1:100,000, is best for tracing lineaments, supplemented by Thematic Mapper imagery band 4 for distinguishing man-made linear features. Bands 1 and 2 of SPOT are preferred for lineament analysis because of the low reflectance range of vegetation. However for lineament analysis, SPOT images with a 20 m resolution are not significantly different from Thematic Mapper images with 30 m resolution. Analysis should be carried out on two or more images and by two or more persons to avoid bias. Fractures measured in the field do not usually reflect the regional tectonic set up. A large part of the lineaments (80 percent) correspond with angular to subangular drainage patterns. All the types of image show the same direction of lineaments in the area of investigation. ESA

N88-28455 Delaware Univ., Newark. Center for Remote Sensing.
SPOT INVESTIGATIONS OF ESTUARIES AND COASTAL ZONES: AN OVERVIEW
V. KLEMAS and M. F. GROSS *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1035-1039 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The spatial, temporal, spectral, and radiometric resolution requirements for coastal and estuarine remote sensing are discussed. These are generally more stringent than those for open ocean or terrestrial applications. While SPOT and LANDSAT TM do not satisfy all coastal requirements, SPOT and TM offer many improvements over other satellite sensors and seem to complement each other's capabilities: SPOT specifically provides major improvements for detecting and mapping coastal land use change; wetlands vegetation and biomass; wetlands creeks and inundation; submerged aquatic vegetation; bathymetry and beach erosion; ship channels and harbor piers; fronts, plumes, and water types. ESA

N88-28457 Dundee Univ. (Scotland). Dept. of Applied Physics and Electronic and Mfg. Engineering.
THE MONITORING OF SEDIMENT TRANSPORT, WATER CIRCULATION AND MIXING IN ESTUARIES AND COASTAL WATERS
A. P. CRACKNELL, J. H. EVANS, and P. A. DAVIES *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1051-1054 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The SPOT data for the estuaries of the rivers Forth and Tay in Scotland were analyzed for studying sandbank movements, estuarine fronts, and the dispersion of pollutants. The results are a little disappointing. While they do not prove that SPOT data are necessarily unsuitable for the three purposes, they do, however, show that in spite of the tilting capability of the SPOT sensor, it is still difficult to obtain good cloud-free data when there are many competing customers for imagery in an area. It is clearly necessary to try to obtain cloud-free SPOT images of estuarine systems at suitable states of the tide so as to enable SPOT data to be evaluated properly. ESA

N88-28458 Delaware Univ., Newark. Center for Remote Sensing.
EVALUATION OF SPOT DATA FOR REMOTE SENSING OF PHYSICAL AND BIOLOGICAL PROPERTIES OF ESTUARIES AND COASTAL ZONES
V. KLEMAS, M. E. GROSS, and M. A. HARDISKY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1055-1062 1988
(Contract NAGW-374)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A LANDSAT Thematic Mapper (TM) and SPOT multispectral image of the Lewes, Delaware Bay area were analyzed. Many distinct Delaware Bay water features evident on the SPOT image are not apparent on the TM image, presumably because of extensive horizontal striping. Thus, SPOT imagery's superior radiometric quality makes it preferable to bands 2, 3, and 4 of LANDSAT TM data for analysis of coastal water masses. The wetland portions of both images were used to compute changes in the vegetation index (VI) from 1984 to 1986 for pixels

representing the dominant salt marsh grass Spartina alterniflora. This procedure reveals substantial variation in relative VI, and presumably also productivity, for similar pixels between years. For monitoring wetland vegetation, SPOT's better spatial resolution facilitates discrimination between areas of vegetation and water, and permits enhanced detection of productivity changes occurring on a small spatial scale. The TM collects data in a blue band and two near infrared bands not covered by SPOT. This may make TM data more useful for distinguishing vegetation types and certain water features. ESA

N88-28459 Service Hydrographique et Oceanographique de la Marine, Brest (France).
UTILIZATION OF SPOT IN HYDROGRAPHY [UTILISATION DE SPOT EN HYDROGRAPHIE]
M. LEGOUIC *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1063-1068 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A strategy for a hydrographic use of SPOT remote-sensing satellite is described: coastal survey preparation, marine chart up-dating, nautical and geodetic data control. The conditions of remotely sensed bathymetric observation and measurement are reviewed. ESA

N88-28466 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
USE OF SPOT HRV DATA IN THE US ARMY CORPS OF ENGINEERS DREDGING PROGRAM
CAROLYN J. MERRY, HARLAN L. MCKIM, NANCY LAPOTIN, and JOHN R. ADAMS (Army Engineer District, Buffalo, N.Y.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1123-1129 1988 Sponsored by the Corps of Engineers Civil Works Remote Sensing Research Program, Evaluation of SPOT and LANDSAT-4 Satellite Data Products, the Buffalo District, New York, the Corps of Engineers, and the Water Resources Support Center Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A water quality sampling program with a dredged material disposal operation and a concurrent SPOT overpass is reviewed. The SPOT HRV 20m multispectral data were classified into five water categories using a maximum likelihood classifier. A post classification filter was used to smooth the water classification. Due to the limited amount of ground truth data, simple empirical models are presented to illustrate the association between turbidity and spectral class. ESA

N88-28467 Ecole Normale Superieure, Dakar (Senegal).
CONTRIBUTIONS OF SPOT IMAGERY TO THE STUDY OF THE LITTORAL ENVIRONMENTS OF SALOUM (SENEGAL)
A. T. DIAW, B. MOUGENOT, M. D. THIAM, and Y. F. THOMAS (Ecole Normale Superieure, Montrouge, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1131-1141 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The Saloum estuary (Senegal) a varied and complex environment was studied using SPOT data. The geographical networks which compose it are determined by a tidal dynamic. Results show the main geomorphological landscapes (mangrove, tanne, sandy spit) and a clear definition of sandy banks which choke the mouth of the Saloum river. The cartography obtained shows also the interest of high resolution radiometers in the study of coastal enviroments and opens a field of investigation in remote sensing: geokinematics. ESA

N88-28511# European Space Agency, Paris (France).
THE WORLD'S WATER RESOURCES: A MAJOR NEGLECT. A STUDY IN REMOTE SENSING IN HYDROLOGY AND WATER MANAGEMENT
R. W. HERSCHY, E. C. BARRETT, J. N. ROOZEKRANS, and J. HUNT, ed. Mar. 1988 41 p Original contains color illustrations
(ESA-BR-40; ISSN-0250-1589; ETN-88-92778) Avail: NTIS HC A03/MF A01

Satellite remote sensing for water management is discussed. The anticipated advantages of satellite remote sensing for hydrology are not likely to accrue unless specific consideration continues to be given to its peculiar demands both for satellite and/or sensor systems, and for its own supporting programs of research, information sharing, education, and training. The chief and most distinctive needs for hydrological sensors are for dual polarized, scanning multichannel microwave radiometers (primarily for rainfall, ice and snow, and soil moisture evaluation and monitoring) and steerable synthetic aperture radars (primarily for more local snow, surface, and sub-surface water evaluation, and mapping). Hydrological user requirements are especially demanding because many hydrological parameters vary rapidly through both space and time, thus calling for data with the highest possible spatial and temporal resolutions. The operational usage of satellite data in hydrology and water management calls mainly for near-real time access to data, the integration of remotely sensed and collateral data sets, and a disseminated network of relatively low-cost, user-friendly, interactive data processing systems. ESA

N88-29077*# Analex Corp., Cleveland, Ohio.
A STATISTICAL RAIN ATTENUATION PREDICTION MODEL WITH APPLICATION TO THE ADVANCED COMMUNICATION TECHNOLOGY SATELLITE PROJECT. 1: THEORETICAL DEVELOPMENT AND APPLICATION TO YEARLY PREDICTIONS FOR SELECTED CITIES IN THE UNITED STATES Final Report
ROBERT M. MANNING Sep. 1986 206 p
(Contract NAS3-24564)
(NASA-CR-179498; E-3187; NAS 1.26:179498) Avail: NTIS HC A10/MF A01 CSCL 20N

A rain attenuation prediction model is described for use in calculating satellite communication link availability for any specific location in the world that is characterized by an extended record of rainfall. Such a formalism is necessary for the accurate assessment of such availability predictions in the case of the small user-terminal concept of the Advanced Communication Technology Satellite (ACTS) Project. The model employs the theory of extreme value statistics to generate the necessary statistical rainrate parameters from rain data in the form compiled by the National Weather Service. These location dependent rain statistics are then applied to a rain attenuation model to obtain a yearly prediction of the occurrence of attenuation on any satellite link at that location. The predictions of this model are compared to those of the Crane Two-Component Rain Model and some empirical data and found to be very good. The model is then used to calculate rain attenuation statistics at 59 locations in the United States (including Alaska and Hawaii) for the 20 GHz downlinks and 30 GHz uplinks of the proposed ACTS system. The flexibility of this modeling formalism is such that it allows a complete and unified treatment of the temporal aspects of rain attenuation that leads to the design of an optimum stochastic power control algorithm, the purpose of which is to efficiently counter such rain fades on a satellite link. Author

N88-30170# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE USE OF ORBITAL REMOTE SENSING DATA FOR LOW COST GROUND-WATER SURVEY
TOMOYUKI OHARA, ROBERTO PEREIRADACUNHA, and MARX PRESTESBARBOSA Jun. 1988 8 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988
(INPE-4587-PRE/1318) Avail: NTIS HC A02/MF A01

A remote sensing survey of alluvial areas in the state of Pernambuco (Brazil) for water resource purposes is presented. Photointerpretation maps of alluvial occurrences (scale 1:100,000), show information obtained from LANDSAT/TM photographic images, including: identification of alluvial areas as a contribution

to underground water research. Additional information includes: updating of road systems, agricultural activities, nucleus and/or rural properties, and maps containing the localization of existing water wells. Based on the information acquired through orbital remote sensing, the government may establish, in short time, emergency plans for water supply needs of the local population. Author

N88-30177# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LANDSAT-TM DATA TO MAP FLOODED AREAS
SERGIO DOSANJOSFERREIRAPINTO and TERESA GALLOTTIFLORENZANO Jun. 1988 9 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4594-PRE/1324) Avail: NTIS HC A02/MF A01

The objective of this study is to identify flooded areas using digital LANDSAT-TM data. The test site is a section along the Parnaiba river (NE of Brazil). By means of a digital processing, the spectral separability of the classes, which are characterized by the presence of water surface with different intensities of a pixel in the near infrared band, are analyzed. A density slicing algorithm is applied for this purpose. The multitemporal analysis of the data is accomplished through the merging of the band 4 images corresponding to normal and flood periods. After this procedure, a maximum likelihood algorithm is applied in both images. The Density Slicing is also applied in multitemporal difference of the image (band 4 normal minus band 4 flood). A comparative analysis of the digital processing techniques using TM data to study flooded areas is presented. Author

N88-30267# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
PASSIVE MICROWAVE MEASUREMENTS OF WATER VAPOR FIELDS AND RAIN FOR LOCATING FRONTS IN CYCLONIC STORMS Final Report, 1 Jul. 1986 - 31 Aug. 1987
KRISTINA B. KATSAROS, IFTEKHAR A. BHATTI, LYNN A. MCMURDIE, and GRANT W. PETTY Mar. 1988 50 p
(Contract N00014-86-K-0453; R35-82)
(AD-A195632; NEPRF-CR-88-01) Avail: NTIS HC A03/MF A01 CSCL 04B

This report describes some basic research techniques and algorithms developed to diagnose fronts in cyclonic storms over the ocean with passive microwave data. The need for this research stems from the limited availability of reliable weather reports over the ocean, and the occasional disruption of weather map transmissions. In earlier work it was found that strong gradients in integrated atmospheric water vapor are good indicators of surface locations of fronts in midlatitude cyclones over the oceans. A second significant indicator of frontal activity is precipitation. Therefore, methods have been developed for flagging strong gradients in integrated atmospheric water vapor (WVG-flag) and the presence of rain by using data from the Scanning Multichannel Microwave Radiometer (SMMR) aboard polar-orbiting SEASAT and Nimbus-7 satellites. The data were not received in real time, but were analyzed from archived tapes. Examination of 65 frontal systems showed the water vapor gradient flag to catch 86 pct of the fronts while the precipitation flagged 90 pct. Each flag emphasizes different portions of the cyclone and are therefore complimentary. Ultimately these techniques are intended for operational use with data from the Special Sensor Microwave Imager (SSM/I) which was launched in June 1987 on a satellite in the Defense Meteorological Satellite Program (DMSP). Such data can be received in real time directly by ships at sea. GRA

N88-30270# Wisconsin Univ., Madison. Space Science and Engineering Center.
VALIDATE ALGORITHMS FOR THE DETERMINATION OF RAINFALL RATES FROM SSM/I MICROWAVE SATELLITE IMAGERY Progress Report, Feb. - Mar. 1988
WILLIAM S. OLSON 5 May 1988 7 p
(Contract N00014-86-K-2001)
(AD-A195428) Avail: NTIS HC A02/MF A01 CSCL 17I

Having completed all software necessary for the validation, we are performing the validation of the Hughes rain retrieval algorithm utilizing validation sites from which we have received comparative radar data. So far we have received radar data from sites in the United Kingdom; Marshall, Colorado; and Cape Canaveral, Florida covering the summer and some of the fall months of 1987. Based on the recommendations of Dr. Gene Poe of NRL, and auxiliary information from James Peirce of Hughes Aircraft Co., we have made long-and cross-track shifts of the SSM/I data and derived products (EDR's) to account for data earth-location errors. Our own investigations have shown that without such adjustments, rain signatures in the satellite data do not correlate with regions of precipitation, which often are relatively small scale. Earth-location errors have been observed to be as great as 25 km downtrack and 12.5 km cross-track (in the direction of scan motion) in the U.K. region on ascending passes, based on comparisons with coastline geography. GRA

N88-30531# Joint Publications Research Service, Arlington, Va.
DETERMINING THE SPATIAL STRUCTURE OF FIELDS OF PRECIPITATION FROM SPACE RADAR IMAGES IN TWO ORTHOGONAL POLARIZATIONS Abstract Only
A. P. PICHUGIN, YU. G. SPRIDONOV, and A. B. FETISOV *In its* JPRS Report: Science and Technology. USSR: Space p 24 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1987 p 70-77
Avail: NTIS HC A04/MF A01

Based on the analysis of radar images produced with a side-looking radar installed on the Cosmos-1500 spacecraft, a study is made of the effective scattering area of precipitation as a function of the characteristics of precipitation fields in the 3-cm band. Use of a dual-polarization method allows study of the 3-D structure of precipitation fields over broad areas over the ocean, determining the spatial distribution of precipitation intensity and more precise measurements of the specific effective scattering area of the ocean surface when precipitation is present. This is important in determining the natural wind velocity field and other hydrophysical parameters. Author

07

DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

A88-46353
MULTITEMPORAL SPOT 1 DATA FOR STUDYING PATTERNS OF THE SANDY COASTS OF POINTE D'ARCAY (VENDEE, FRANCE) [DONNEES MULTITEMPORELLES SPOT 1 POUR L'ETUDE DU REGIME DES COTES SABLEUSES LA POINTE D'ARCAY /VENDEE, FRANCE/]
F. VERGER, L. WANG, F. CUQ, and D.-C. HE (CNRS, Paris, France) Photo Interpretation (ISSN 0031-8523), vol. 26, Mar.-Apr. 1987, p. 29-33, 35, 37. In French, English, and Spanish.

A88-46357
THE MAPPING OF SURFACE FORMATIONS IN AN ARID ZONE (SOUTHERN TUNISIA) USING THE LANDSAT TM [CARTOGRAPHIE DES FORMATIONS SUPERFICIELLES EN ZONE ARIDE /TUNISIE MERIDIONALE/ AVEC LANDSAT TM]
R. ESCADAFAL and M. POUGET (Office de la Recherche Scientifique et Technique d'Outre-Mer, Unite de Teledetection, Bondy, France) Photo Interpretation (ISSN 0031-8523), vol. 26, July-Aug. 1987, p. 9-13, 15. In French, English, and Spanish.

A88-46664
CARTOGRAPHY BY COMPUTER - DIGITAL MEMORY SYSTEM FOR HIGH-RESOLUTION IMAGING DEVELOPED BY MBB
New-Tech News, no. 2, 1988, p. 28, 29.

A proprietary digital image processing, storage, and display system has been developed that is applicable to robot controls, component quality control, printed circuit-board testing, and contactless measurement of large, complex objects. Attention is presently given to the cartographic application of this system, which allows the distance between points on a given map to be automatically computed and displayed, and permits extensive color-keyed differentiation of such topographical features as forest cover, hydrologic features, and urban structures. O.C.

A88-48449
QUALITY CONTROL OF HEIGHT ACCURACY OF DIGITAL ELEVATION MODELS
ANTONIO E. BALCE (Department of Forestry, Lands and Wildlife, Alberta Bureau of Surveying and Mapping, Edmonton, Canada) ITC Journal (ISSN 0303-2434), no. 4, 1987, p. 327-332. refs

Both experimental and analytical methods can be used for assessing the height accuracy of digital elevation models (DEMs). Experimental methods include direct surveying using conventional and nonconventional positioning systems, photogrammetric methods including aerial triangulation points from photographs larger than or the same scale as the DEM photographs, and test points measured during or after DEM sampling. Analytical methods include least squares, Fourier transforms, variograms and transfer functions. Experimental results using photogrammetric methods with test points measured after DEM sampling and analytical methods using Fourier transforms and variograms are presented. Author

A88-49365
THE REMOVAL OF AZIMUTH DISTORTION IN SYNTHETIC APERTURE RADAR IMAGES
J. W. WOOD (Royal Signals and Radar Establishment, Malvern, England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1097-1107. Sponsorship: Ministry of Defence of England. refs
(Contract MOD-A54B/1809)

The sources of distortion in Synthetic Aperture Radar (SAR) imagery are discussed. The Royal Signals and Radar Establishment airborne SAR system is described briefly and a phase correction scheme, based on autofocus measurements, to remove azimuth distortions is derived with the requirements for accuracy and update frequency of autofocus measurements. Examples of the application of the techniques to real SAR data are given. Author

A88-49370
RIDGE AND VALLEY LINE EXTRACTION FROM DIGITAL TERRAIN MODELS
SERGE RIAZANOFF (DGLA, Rungis; Paris VI, Universite; Paris VII, Universite, France), BERNARD CERVELLE (Paris VI, Universite; Paris VII, Universite, France), and JEAN CHOROWICZ (Paris VI, Universite, France) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, June 1988, p. 1175-1183. refs

A new method for ridge and valley line extraction from digital images has been developed. This method is based on lines drawn by moving under logical constraints in the image, starting from previously selected points. Compared to classical statistical processing, this approach, which is termed 'structuralist', leads to results that allow a better understanding of image topography. Three algorithms based on this dynamic method are presented and applied to a digital elevation model. Author

A88-50321
A HIERARCHICAL METHOD OF REMOTELY SENSED MULTISPECTRAL HIGH RESOLUTION IMAGE CLASSIFICATION
H. LIN and D. VIDAL-MADJAR (Centre de Recherches en Physique de l'Environnement, Issy-les-Moulinaux, France) IN: Advances in image processing; Proceedings of the Meeting, The Hague, Netherlands, Mar. 31-Apr. 3, 1987. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 53-55. refs

One of the simplest classification algorithms which utilizes a linear discriminant function is known as the minimum-distance classifier. It is widely used in pattern recognition, but it encounters the problem of useless dimension compensation when the feature dimensionality is very large. This is the situation when textural features are to be used as input parameters for classification, as is now possible with remotely sensed high-resolution images (optical or radar). To avid this problem, a hierarchical classification algorithm is proposed. Author

A88-52452#
THE POTENTIAL OF SPOT FOR TOPOGRAPHICAL MAPPING
BERTRAND GALTIER (Institut Geographique National, Saint-Mande, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 403-409.

The applicability of SPOT to 1:50,000 and 1:100,000 topographical mapping is discussed. The advantages of using SPOT include 3600 sq km coverage with one image, quick access to data, high geometrical accuracy, a low number of control points, and the ability to record stereoscopic images. The use of computer processing, relief plotting on an analytic restitution system, and landscape detail plotting are discussed. Tables comparing the use of SPOT with traditional mapping techniques are also presented. R.B.

A88-52453#
THE AUTOMATED EXTRACTION OF DIGITAL TERRAIN MODELS FROM SATELLITE IMAGERY
RICHARD SWANN, JOHN S. MACDONALD, ANDREW WESTWELL-ROPER, SCOTT WOOD, and WATSON LAING (MacDonald Dettwiler and Associates, Ltd., Richmond, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 411-424. refs

Digital Terrain Models (DTMs) record information about earth surface elevations in a form that can be processed by computer-based systems. Unlike contour maps, which record the same sort of information but in an analogue format, DTMs can be used directly by a host of automated systems for civil and environmental engineering, as well as for precision correction of satellite imagery. Until now DTMs have been derived from aerial photographs by traditional photogrammetric methods which are labor intensive, time consuming and extremely costly. MacDonald Dettwiler has developed a system for extracting DTMs automatically from stereo pairs of satellite images. This paper surveys current DTM applications, the advantages of automatically extracting DTMs from satellite imagery, other attempts at deriving DTMs from spaceborne imagery, and recent research into DTM extraction from Landsat Thematic Mapper and SPOT imagery. Author

A88-52465#
THE UTILITY OF LANDSAT TM IMAGERY IN THE INLAND DELTA CARTOGRAPHY OF MALI
MAMERY DIAKITE, MICHEL YERGEAU, and FERDINAND BONN (Sherbrooke, Universite, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 567-574. refs

Landsat TM imagery was used to map the inland delta of the Niger River. The raw data had an accuracy of 56 percent. The data were numerically enhanced and classified according to supervised techniques using the maximum likelihood algorithm. The resulting maps are compared with an earlier morphopedological map. The microrelief basins and decanting basins were classified with 77 and 70 percent accuracy, respectively. R.B.

A88-52478#
DECENTRALIZED DIGITAL PROCESSING OF REMOTE SENSING DATA ON MICROCOMPUTERS
KJELD RASMUSSEN, HENRIK SOGAARD, and JORGEN HOLM (Copenhagen, University, Denmark) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 761-770. CEC-supported research. refs

Decentralization of processing satellite data is a necessary prerequisite for bringing satellite remote sensing into practical use in an African context. This study analyzes how it can be done. A suitable low-cost system for decentralized image-processing is described, information needs and relevant data assessed. The flow of data from receiving station to end-user is discussed, as well as the division of labor, in terms of image processing steps, between receiving station and decentral users. Examples of NOAA-processing in the prototype low-cost system are presented, and it is demonstrated that temperature albedo, and vegetation index can be monitored efficiently. The significance of the parameters and their interrelationships are discussed. It is concluded that even though problems with data transfer and analyzing methods still remain, the proposed system can serve as a first step toward integrating remote sensing technology into practical use. Author

A88-52482#
SPOT IMAGES PREPROCESSING USED TO INCREASE THE IMAGE SIZE AND THE MULTISPECTRAL RESOLUTION
D. PRADINES (CNES, Toulouse, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 813-820.

Methods for mosaicking SPOT images and increasing the ground resolution of the multispectral data are presented. In the mosaicking method, data are acquired with both HRV instruments in the twin mode of operation to obtain an image size of about 117 X 110 km. The panchromatic and multispectral imaging geometries are compared, and a method for obtaining 10 m resolution for multispectral data is introduced. The influence of attitude variation, relief and the relative position of the linear arrays are discussed. Examples of the methods and their applications are given. R.B.

A88-52483#
DESERTIFICATION COMBATING IN THE SOMALI COASTAL REGION - THE POTENTIALS OF DIGITAL REMOTE SENSING
ANETTE REENBERG (Copenhagen, University, Denmark) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 835-844.

A88-52488#
SPOT IMAGE PROCESSING FOR HELP IN INTERPRETATION
BERTRAND FLEUTIAUX, MARIE-JOSE LEFEVRE, CATHERINE PROY, DOMINIQUE PRADINES, BERNARD ROUGE (CNES, Toulouse, France) et al. IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 915-929.

Algorithms developed to accommodate the geometric and radiometric characteristics of SPOT imagery are introduced. Automatic information extraction techniques are presented, including segmentation by multispectral and monospectral analysis and edge extraction to eliminate rural land parcels from a panchromatic image to separate urban areas from the different networks. Techniques for improving visual output include mastering color in the reproduction of imagery, automatic digital mosaicking of multidate images, and processing for three-dimensional output. Examples of the use of these techniques are given. R.B.

A88-52520#
SPATIAL CARTOGRAPHY WITH SPOT IMAGERY
TH. TOUTIN and G. ROCHON (Digim (1983), Inc., Montreal, Canada) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1245-1254.

The development of a system for base mapping using SPOT stereoscopic images and GPS points as input is discussed. The system consists of an image analysis system with an array processor, an interactive graphics processing system, microcomputers for image interpretation, and input and output devices. The system uses spatio-triangulation points, the digital terrain model, orthoimages, spatiomaps, and topographic and thematic maps. The ability of SPOT to compete with maps derived from photographic surveys is evaluated. It is suggested that for digital mapping at a scale of 1:50,000 or smaller the system will have three major advantages: reduction of production costs, reduction in production delays, and the possibility of integrating digital products with remote sensing images from other sources and geographic information systems. R.B.

A88-52535#
SPACE MAPS - A NEW CARTOGRAPHIC TOOL DERIVED FROM SATELLITE IMAGERY AND GEOGRAPHIC DATA BASES
BERTRAND GALTIER and ISABELLE DESTIVAL (Institut Geographique National, Saint-Mande, France) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1393-1402.

The production of space maps by integrating remote sensing data and information from a geographic data base is examined. Software systems used in the insertion of zonal themes and linear cartographic data, place-name file editing, standard marginal information, file combination and correction, and cartographic production are discussed. The accuracies of maps based on MSS, TM, and SPOT data are compared. The classification of documents is considered and examples of map production are presented. R.B.

A88-52536#
AN EXPERIMENT ON THE INVESTIGATION OF SPOT IMAGERY FOR TOPOGRAPHIC MAPPING IN SUDAN
ABDALLA ELSADIG ALI (Khartoum, University, Sudan) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1403-1409.

A88-52538#
'SPECTRAL MAPS' - LOGICAL CONSEQUENCE OF IMAGE OPTIMIZATION AND DIGITAL CARTOGRAPHY
H. KAUFMANN and G. SCHWEINFURTH (Karlsruhe, Universitaet, Federal Republic of Germany) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 1423-1428. refs

The combination of image enhancement and digital cartography to produce maps which display a wide range of spectral image contents is presented. It is shown that a combination of Landsat TM bands 1, 4, and 7 is most relevant for rock and soil discrimination. The method ensures the preservation of image contents without the loss of structural information. The method of decorrelation and the processes of map production are examined. A map of a test site in Saudi Arabia is presented to illustrate the applicability of the methods. R.B.

A88-55343#
ACCURACY ESTIMATION AND SELECTION OF CLASSIFICATION METHOD FOR REMOTELY SENSED DATA PROCESSING

S. LAKSHMANAN, M. MARUTHACHALAM, and R. PALANIVELU (Anna University, Madras, India) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p.
(IAF PAPER 88-141)

SPOT imagery of a densely populated city area and Landsat TM imagery of a dense watershed area have been compared to study the accuracy of training sets using kurtosis, a statistical measure of dispersion. The coefficient of kurtosis were calculated for all bands of each training set. It was found that when the kurtosis coefficient was zero, the maximum likelihood classifier gave better classification accuracy. When the coefficient of kurtosis was leptokurtic, better results were achieved with the minimum distance rule of classification. It is concluded that the coefficients of skewness and kurtosis can be used in selecting the right combination of bands for classification purposes and for choosing the classification method. R.B.

N88-28345# Army Engineer Topographic Labs., Fort Belvoir, Va.
RESEARCH FOR REDUCING THE LABOR INTENSIVE NATURE OF HIGH-RESOLUTION TERRAIN ANALYSIS FEATURE EXTRACTION
DANIEL EDWARDS 8 Oct. 1987 12 p
(AD-A192661; ETL-R-131) Avail: NTIS HC A03/MF A01 CSCL 08B

Based on terrain analyst productivity estimates of 1000 man-hours per 15 by 15 arc-minute area, the time required to complete a single terrain analysis of the world's land surface exceeds several hundred thousand man-years. Another dilemma arises from the way we currently store and use spatial data. Current geographic information system techniques emphasize a brute-force search approach to spatial storage, query and analysis. If global high-resolution terrain data were available, the response time for certain brute-force data base queries might approach the above time estimates for compilation. The following research strategies are discussed which address the high-resolution dilemmas. First, terrain feature extraction should be approached from a minimum compilation, maximum analysis strategy. In other words, map only the key terrain components, and gather additional information by thorough analysis and inferencing from this compiled spatial data. This basic approach parallels techniques used extensively in manual photo-based terrain analysis. Secondly, knowledge needs to be incorporated into all phases of terrain data compilation, storage and analysis. Low-level geometric knowledge of spatial features can be used to organize and group data together that are important at a higher symbolic level of terrain understanding. Similarly, high-level knowledge and models of regional factors such as climate and geomorphology can be used to constrain brute-force search, detect errors and handle incomplete information. GRA

N88-28346 Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 1 IMAGE UTILIZATION, ASSESSMENT, RESULTS
1988 1552 p In ENGLISH and FRENCH Conference held in Paris, France, Nov. 1987; sponsored by CNES, SPOT Image Co., and Inst. Geographique National, France Original contains color illustrations
(ISBN-2-85-428188-8; ISSN-0766-1002; ETN-88-92763) Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT images in water and agricultural management; geography and the environment; land use and urban research; oil and mineral exploration; forestry; coastal and ocean studies; and topography was discussed. Image quality; image processing; user training; and program perspectives were considered.
ESA

N88-28384 Fjellanger Wideroe A.S., Oslo (Norway).
USE OF SPOT IMAGERY FOR VEGETATION/BIOMASS MAPPING, GEOTECHNICAL MAPPING, CATCHMENT AREA DETERMINATION, AND SETTLEMENT LOCATION IN THE TURKANA DISTRICT, NORTHERN KENYA
O. DICK and E. LOBERG *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 371-380 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Data from SPOT and LANDSAT MSS were compared. It is shown that SPOT imagery represents a considerable improvement compared to LANDSAT MSS, except in vegetation index mapping where an integration of the reflected radiation measurement over a certain area is of importance. The SPOT PA may replace small scale aerial photography, but for the detection of settlements of the type encountered, PA is not always sufficient in terms of details. When the SPOT user can apply digital data, this is recommended, even though the cost of digital data is higher than the cost of corresponding standard photographic material, and also that digital image processing represents a cost element, the digital approach is deemed as cost-effective unless the purpose of the use of the SPOT data is just to obtain a general overview over a certain area. In such cases standard photographic material is considered as adequate. ESA

N88-28386 SPOT Image Corp., Toulouse (France).
A COMPARATIVE THEMATIC MAPPING ANALYSIS OF SPOT DATA: THE VIENTIANE PLAIN (LAO PDR)
D. BOREL, KAEW NUALCHAWEE, and PHADEJ SAVASDIBUTR (Mekong Committee Secretariat, Bangkok, Thailand) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 391-398 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Based on the multitemporal analysis of 4 SPOT images acquired at selected dates throughout the period Apr. 1986 to Feb. 1987, the soils and geomorphology, irrigation, drainage and flood zoning, cultural landscape and land use in the Vientiane Plain (Laos) were studied. Visual and digital analysis techniques were used, concurrently with field data collections performed in syncrhonism with the image acquisitions by the satellite. Results were evaluated with respect to reference maps at 1/100,000 scale completed through the photointerpretation of images acquired during an airborne campaign. They stress the value of SPOT data for the monitoring of environmental changes within the whole geographical to which the Ventiane plain belongs, i.e., the Korat plateau (100,000 sq km). ESA

N88-28412 Gadjah Mada Univ., Yogyakarta (Indonesia).
THEMATIC MAPPING OF CENTRAL JAVA (INDONESIA)
J. P. GASTELLU-ETCHEGORRY, D. DUCROS-GAMBART, D. ISAACSON, P. HILLEGERS (Wageningen Agricultural Univ., Netherlands), and M. OBBRINK *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 647-652 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In order to test the real potential of SPOT digital data and their operationality in Indonesia a thematic classification of an area south of Surakarta, Central Java, was processed with locally available and maintained equipment. The procedures and results are discussed. Results are encouraging. ESA

N88-28470 University Coll., London (England).
THE PROSPECTS FOR TOPOGRAPHIC MAPPING USING SPOT DATA
I. J. DOWMAN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1163-1172 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Methods for modeling the geometry of SPOT images, are considered and implementations of the models are assessed. Products and results are reviewed. Prospects for the use of SPOT data image maps, line maps, and digital elevation models are evaluated. Stereo restitution instruments, image processing systems, and automatic systems using image correlation are discussed. Prospects for topographic mapping are excellent,

although data availability can be problematic due to, e.g., cloud cover. ESA

N88-28472 Department of Mapping and Surveying (Australia).
CARTOGRAPHIC APPLICATIONS OF SPOT IMAGERY
RUSSELL PRIEBBENOW and ENRICO CLERICI (Queensland Inst. of Tech., Brisbane, Australia) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1189-1194 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The suitability of stereoscopic SPOT imagery for the production of topographic maps was investigated. While the accuracy achievable from the imagery is well within 1:50,000 mapping specifications, the interpretability of the imagery presents difficulty in mapping at scales as small as 1:25,000. However, it is possible to rectify aerial photography to produce orthophoto maps which meet 1:25,000 accuracy specifications, using control points and a digital terrain model (DTM) derived from stereo SPOT imagery. This is an efficient method of producing orthophoto maps, since it reduces the amount of field work required to provide control, and the measurement time of the DTM. ESA

N88-28473 Institut Geographique National, Paris (France).
THE USE OF SPOT IMAGERY FOR TOPOGRAPHIC MAPPING
ALAIN JALOUX *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1195-1203 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Two SPOT scenes of Ghardia (Algeria) were used to produce topographic maps. A study of the results, the photogrammetric plotting in particular, allows judgment of the accuracy obtained, defines the optimum scale of this mapping, and defines adapted products from satellite imagery for a lower cost and delay. Depending on the purpose and according to the amount of diffusion desired, the products can be in black and white or color and either as line maps or with a background to be used as survey maps or topographic maps. ESA

N88-28475 University Coll., London (England). Dept. of Photogrammetry and Surveying.
THE USE OF SPOT DATA FOR MAPPING AND DEM PRODUCTION
I. J. DOWMAN, D. J. GUGAN, J.-P. MULLER, and G. PEACEGOOD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1213-1220 1988 Sponsored in part by the Natural Environment Research Council and the Ordnance Survey of Great Britain, Surbiton, United Kingdom
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The geometry of the dynamic SPOT imagery was evaluated and software developed for the restitution of mono and stereo imagery in a photogrammetric analytical plotter and in a fully digital stereo system. The geometric model, the mapping systems developed, and the approach for the automatic production of digital elevation model data are described. Photogrammetric stereo systems were used to orientate the stereo models and the accuracies obtained are presented. Digital elevation models were produced. Monoscopic imagery of Tanzania and an existing map were used for comparison with LANDSAT Thematic Mapper imagery for evaluating the extraction of small scale map detail in developing areas. Various image enhancement techniques were evaluated to maximize information extraction. Stereo panchromatic imagery of Cyprus (level 1A and 1B), England (1A) and level 1P imagery of the Marseille area (France) were evaluated. Accuracy and information content of SPOT imagery is suitable for topographic mapping at scales of 1:50,000 to 1:100,000 with 20 to 30m contours. ESA

N88-28476 Institut Geographique National, Paris (France).
EVALUATION OF SPOT CARTOGRAPHIC CAPABILITIES OVER THE AIX MARSEILLE AREA (FRANCE)
P. FOIN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1221-1227 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The image photogrammetric capabilities of SPOT (altimetry and planimetry) and other capabilities: classifications to retrieve the main surface themes of the 1:100,000 map, feed a data bank, contribute to agricultural studies, and information retrieval on photographic documents to update topographic maps were assessed, using 10 images of 2 scenes. The results are consistent, complying with estimates. Metric accuracy is excellent and better than the standards provided for before launch. The information content is less reliable, though utilizable, over this particularly complex area, because of an extremely small and varied agricultural pattern. ESA

N88-28478 Technische Univ., Hanover (West Germany). Inst. fuer Photogrammetry and Engineering Surveys.
A GEOMETRICAL ANALYSIS OF SPOT DATA
M. MICHAELIS *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1235-1243 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

It is shown that geodetic rectifications of SPOT level 1A scenes acquired with off-nadir views of 8 deg can be performed by polynomials with subpixel accuracies. Transformations by 1st degree polynomials produce subpixel accuracies of 0.6 to 0.8 pixel in along-track direction. In across track direction residuals of 2.5 to 3.1 pixel are achieved, indicating the inefficiency of an affine transformation to describe the distortions in this direction. The use of 2nd order polynomials proves sufficient to fit the scenes to topographic maps of 1:50,000 scale. Accuracies of 0.6 to 0.8 pixels in along-track and 0.6 to 0.9 pixel in across-track direction are achieved. In order to shorten the time consuming measurement of ground control points, a precorrection statement was defined, which allows a rectification with subpixel accuracies for both directions by the use of 1st degree polynomials with a few points only. This correction function is computed once for each detector of the linear array and stored in a look-up table. ESA

N88-28479 Ordnance Survey of Great Britain, Surbiton.
TOPOGRAPHIC MAPPING WITH SPOT 1 DATA. A PRACTICAL APPROACH BY THE ORDNANCE SURVEY
W. S. HARTLEY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1245-1265 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT-1 HRV data for topographic line mapping at 1:100,000 scale in the Yemen Arab Republic was tested. Results indicate that sufficient accuracy to support 1:100,000 mapping with a 40m contour interval is possible but that the compilation of detail is incomplete. More emphasis in field completion/verification is required than with traditional techniques to maintain a standard 1:100,000 mapping specification. Costs of mapping large areas can be significantly reduced but savings are yet to be made in providing ground control. ESA

N88-28480 Institut Geographique National, Paris (France).
METRIC APPLICATIONS OF SPOT'S LATERAL STEREOSCOPY
P. DENIS *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1267-1272 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT to get a 3D representation of the Earth surface is reviewed. The main applications of this stereoscopic capability are the determination of the three coordinates of ground points, using a minimal ground control-equipment (block space triangulation); photogrammetric stereoplotting on analytical plotters for map production: digital automatic correlation, allowing a quick digital terrain model (DTM) output over the involved area; and improvement of feature identification. The by-products are numerous: level 3 preprocessed scenes (digital or photographic

mosaics); regular topographic maps and study maps; map up-dating, special products such as DTM and perspective views.
ESA

N88-28481 Geological Survey, Sioux Falls, S. Dak.
LARGER SCALE IMAGE MAPPING WITH SPOT
JUNE M. THORMODSGARD and JAY W. FEUQUAY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1273-1279 1988 Prepared in cooperation with TGS Technology, Inc., Moffett Field, Calif. Original contains color illustrations
(Contract USGS-14-08-0001-22521)
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

To determine and evaluate the limits in map scale that can be achieved with SPOT data, a 1:24,000-scale product was created by merging panchromatic (10m resolution) and multispectral (20m resolution) image data acquired over the San Diego, California, area. The resultant image map was evaluated in terms of visual appearance, image content, and geometric accuracy. The overall visual quality of the color product is acceptable at 1:24,000 scale and compares favorably to the existing orthophotoquad created from black-and-white aerial photography. While the inherent resolution of the orthophotoquad is greater, the image map is an excellent resource for identification of areas that need map revision. An assessment of the geometric accuracy shows that this product meets National Map Accuracy Standards for 1:50,000 scale, but further refinements in the processing of the data are required to meet requirements at larger scales. ESA

N88-28482 Energy, Mines and Resources Canada, Ottawa (Ontario).
RIGOROUS STEREOPHOTOGRAMMETRIC TREATMENT OF SPOT IMAGES
V. KRATKY *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1281-1288 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A photogrammetric treatment of SPOT stereo images in three-dimensional space was developed for use in digital systems and analytical photogrammetric instruments. All needed geometric, orbital, and cartographic relations are formulated without any inherent approximations. High accuracy of the geometric model reconstruction is supported by a series of auxiliary transformations between all coordinate systems involved in the process. The modular character of the developed software facilitates a straightfoward programming of many other relevant orbital and geometric image processing tasks. Analysis, experiments, and feasibility tests prove the viability and accuracy of the formulation.
ESA

N88-28483 New South Wales Univ., Sydney (Australia). Center for Remote Sensing.
MAPPING AND URBAN MULTI-EXPERIMENTAL ASSESSMENT OF SPOT: MAPPING RESULTS
B. C. FORSTER, J. C. TRINDER, D. CARROLL, R. FARRINGTON (Department of Administrative Services, Canberra, Australia), and L. KWOH *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1289-1295 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

P-mode SPOT data processed to level 1A and 1B were acquired over Sydney (Australia) and surrounding areas. Overlapping images with a B/H ratio of one were examined in a single image, image to ground registration experiment to determine the optimum number and distribution of points, and in a stereo-mode as part of the development of an analytical solution for an analytical plotter. The optimum number of control points for single digital image to ground registration is nine distributed in bands of three over the image. A similar number of ground control points was also determined as optimum for a three dimensional solution. Root mean square errors are of the order of 10m for X and Y and 5m for Z. However, lower values would be achieved with more accurate control points. ESA

N88-28484 Institut Geographique National, Paris (France).
STUDY OF STEREORADIOMETRY ON SPOT IMAGES
M. LEMEN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1297-1304 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The possibility of measuring the variation of reflectance of natural objects on SPOT images, and using this variation in thematic studies were assessed. It is shown that SPOT data can be calibrated to a reasonable accuracy without any outside data using a simple atmospheric model and auxiliary image data. This possibility can be used in multitemporal processing and thematic applications. Correction of lighting effects due to relief also improves radiometric classifications. This type of calibration is necessary to produce mosaics of images taken from different angles. For stereoradiometry, the results show that the variation of reflectance with angle of observation is detectable in all SPOT bands and can be measured in the green and especially in the red bands. The effect is too weak to be measured in the infrared. The stereoradiometric effect seen in the SPOT images agrees with ground measurements. ESA

N88-28485 National Space Development Agency, Tokyo (Japan). Earth Observation Centre.
STUDIES ON SYSTEM PERFORMANCE OF SPOT (SPACE AND GROUND SEGMENTS) Final Report
KOHFI ARAI, SHINKICHI KOIZUMI, KOICH AYABE, HIDEO SATO, SHIZUO YAMAMOTO, TAKASHI NAKAZAWA, KAZUO TACHI, NOBUYOSHI FUJIMOTO, KIYOSHI TSUCHIYA (Chiba Univ., Japan) et al. *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1305-1313 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

An analysis of SPOT HRV data is summarized. The geometric distortion in the along track direction is extremely small while that of the across track is 30 pixels which may be attributable to errors in estimation of satellite position or rolling or a misaligment of the sensor. Due to the fact that there is no complex geometric distortion in the SPOT image, it can be concluded the SPOT bus is fairly stable. Geometric distortion included in the raw SPOT HRV data (level 1) can be described with 2nd order polynomial for both longitude and latitude directions while for the level 1b data, linear expression is the most effective in terms of computation time and residual geometric distortion. Root mean square errors in terrain height estimation using stereo pairs are within a range between 24.2 and 26.6 m, while that of LANDSAT TM data is 98.0 m. ESA

N88-28487 Societe Europeenne de Propulsion, Puteaux (France).
AUTOMATIC PRODUCTION OF ORTHOPHOTO USING SPOT IMAGES
M. MILLOT and P. N. PASCAUD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1325-1330 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Stereo pairs of SPOT images were used to generate Digital Terrain Models (DTM) with an automatic procedure. The package proves its efficiency for the automatic DTM computation and orthophoto production, and confirms the topographic use of SPOT images. Products derived from the DTM include contour intervals. The DTM itself can be considered as a product. Three dimensional perspectives of the DTM, including Sun illumination are produced. Products derived from the images include stereoscopic couples, used in a interactive way to validate the computed DTM, or to improve the altimetric precision of the DTM; and three dimensional perspectives of the images. ESA

N88-28488 Barringer Research, Inc., Golden, Colo.
HIGH RESOLUTION ORTHOIMAGE QUADRANGLE MAPS USING SPOT SATELLITE DATA
S. I. GUTMAN and A. L. KLAWITTER *In* CNES, SPOT 1 Image

Utilization, Assessment, Results p 1331-1338 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Geometrically accurate, high resolution satellite image maps were produced from SPOT digital data through the application of conventional digital image processing techniques and geographic information systems. This product, called the satellite orthoimage, is comparable in quality and accuracy to U.S. Geological Survey 7.5 Minute Orthophoto Quadrangles. A 1:24,000 scale satellite image map of the Black Butte, Wyoming 7.5 Minute Topographic Quadrangle was created with an RMSxy positional accuracy (at the 90 percentile confidence level) of + or - 14 m; this is within 15 percent of meeting U.S. National Map Accuracy Standards. The applicability and utility of the satellite orthoimage is demonstrated by the absence of up-to-date photographic coverage and/or accurate topographic maps in developed and developing nations of the world. An example in the United States is presented. Factors which determine the technical and economic viability of satellite orthoimages as an alternative to high-altitude aerial photography include: sharpness and resolution compared with conventional products; geometric or mapping fidelity; and timely, economical availability of imagery. ESA

N88-28489 GeoSpectra Corp., Ann Arbor, Mich.
AUTOMATIC EXTRACTION OF HIGH RESOLUTION ELEVATION DATA FROM SPOT STEREO IMAGES
ROBERT K. VINCENT, MICHAEL A. TRUE, and PETER K. PLEITNER *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1339-1345 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Panchromatic SPOT level 1-A digital stereo data was computer processed and correlated to extract elevation data, then one of the panchromatic images was resampled to an orthographic projection. Elevation data and planimetric data were analyzed in terms of the control methodology employed. Recommendations are offered for further improvements, and analytical methodologies are discussed. Non-cartographic applications for SPOT three-dimensional image data bases are summarized. ESA

N88-28490 Institut National de Recherche d'Informatique et d'Automatique, Valbonne (France).
AUTOMATIC CREATION OF DIGITAL TERRAIN MODELS FROM SPOT IMAGE PAIRS [CREATION AUTOMATIQUE DE MNT A PARTIR DE COUPLES D'IMAGES SPOT]
LAURENT RENOUARD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1347-1355 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Use of SPOT data to produce 3D images is reviewed. Automatic extraction of digital elevation models from SPOT stereo scenes adds a dimension to remote sensing. The method developed for this purpose yields results accurate both on vertical and horizontal localizations. Primarily designed to meet structural geology needs, the resulting software has a variety of applications, e.g., cartography and geographical. ESA

N88-28492 Water Conservation Lab., Phoenix, Ariz.
SURFACE REFLECTANCE FACTORS DERIVED FROM SPOT-1 HRV DATA AT TWO VIEW ANGLES
M. S. MORAN, R. D. JACKSON, G. F. HART, P. N. SLATER, R. J. BARTELL, S. F. BIGGAR, and R. P. SANTER (Arizona Univ., Tucson.) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1365-1370 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Multispectral and panchromatic SPOT data were acquired over an agricultural area on two consecutive days at view zenith angles of +23.0 and -10.7 deg. Digital data were converted to radiances using the SPOT-1 internal calibrator coefficients. A radiative transfer model, using optical depth data measured on overpass days, was used to calculate surface reflectance factors from the radiances. Differences between satellite, aircraft, and ground-based surface reflectance factors over bare soil, at the same view and solar zenith angles, are within 0.014. A view angle correction was computed from ground-based measurements of radiance from bare soil at numerous view angles. Satellite-based reflectance values for bare soil, trees, and full cover crops that originally differed by over 0.09 on the 2 days are brought to within 0.005 difference in all 3 XS bands. The correction overcompensates for view angle effects over planar surfaces, i.e., water and roads. ESA

N88-28493 SPOT Image Corp., Toulouse (France).
DIGITAL SPOT STEREOPLOTTING: AN ORIGINAL APPROACH TO THE FORMATION OF EPIPOLAR IMAGES AND MATCHING [STEREORESTITUTION NUMERIQUE SPOT. UNE APPROCHE ORIGINALE DE FORMATION DES IMAGES EPIPOLAIRES ET DE MISE EN CORRESPONDANCE]
H. GUICHARD, G. RUCKEBUSCH, E. SUEUR, and S. WORMSER (MATRA Service Aerodynamique, Velizy-Villacoublay, France) *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1371-1392 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

An automatic stereoplotting method starting from digital SPOT images, which features construction of epipolar images utilizing a mathematical model of terrain to image deformation and a matching algorithm robust to radiometric distortions between the images, is presented. The existence of epipolar lines, defined for SPOT with a discrepancy less than 1m for an elevation up to 4000m and similar to line segments for a length greater than 1 km, is demonstrated. Images are resampled in the epipolar geometry and then preprocessed in order to decrease their radiometric distortions. The approach presented aims at a tradeoff between performance and computing requirements by applying a dynamic programming algorithm not on a whole epipolar line but only between pairs of recognized homologous points, detected with a strict criterion on the correlation function. ESA

N88-28494 Institut Geographique National, Paris (France).
FROM THE EXTRACTION OF LINEAR NETWORKS TOWARDS FOLLOWING OF THEM ON SPOT IMAGES WITH THE HELP OF A KNOWLEDGE-BASED INTERPRETATION SYSTEM
I. DESTIVAL *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1395-1402 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Image segmentation algorithms for extracting parcels of land were developed for use with SPOT images. Parcels are then analyzed by set transformations taking into account their composition, texture, shape, etc. Other processes must be defined for the recognition of thin elements. Gray level detection operators, and work on expert system for the rebuilding and following of road and railway networks are discussed. ESA

N88-28495 Institut National de Recherche d'Informatique et d'Automatique, Valbonne (France).
EXTRACTION OF THIN NETWORKS BY AN ORIENTED FOLLOWING OF RIDGES AND VALLEYS
MARY ALINE SERENDERO and MARC BERTHOD *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1403-1412 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

High resolution of SPOT panchromatic images was used to detect several categories of networks (roads, rivers, railways). Some of these are thick enough to be formed of two parallel edges; others, thinner, correspond to lines. These are extracted by standard off-the-shelf algorithms, but then are noisy and incomplete. A line detector which performs reliable extraction of thin linear structures is presented. It relies on the cooperation

between an edge linking algorithm and another algorithm which follows lines (ridges and valleys) in the gray level image. ESA

N88-28496 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SPOT IMAGES FEATURES EXTRACTION
F. BRETAUDEAU, C. ENAULT, and P. SECCHI *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1413-1420 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A set of techniques applied to remotely sensed images, obtained from SPOT satellite are presented. They were developed to extract the main image features (cities, mountains, agricultural areas) and to act as a first step towards roads, railways, and river systems determination. The methods use local statistical properties of image radiometry and are based on SPOT image segmentation. ESA

N88-28497 Institut Geographique National, Paris (France).
SPOT: A DATA CAPTURE AND DATA UPDATING TOOL FOR THE FRENCH NATIONAL GEOGRAPHIC INSTITUTE'S (IGN'S) CARTOGRAPHIC DATA BASE
FRANCOIS SALGE, MARIE-JOSE ROOS-JOSSERAND, and PHILIPPE CAMPAGNE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1421-1428 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A digital cartographic data base for all the information contained in maps from 1:100,000 to 1:1,000,000 is proposed. Planimetric localization accuracy of the data is compatible with the SPOT resolution and the future capabilities of positioning systems. Remote sensing applications, concerned by the 1:100,000 scale since the launching of SPOT, will be among the users of this data base; for example it will give them topographic descriptions for image-field correlation. The SPOT imagery is useful for the updating of object geometric descriptions, and for land cover information capture. ESA

N88-28503 Centre National d'Etudes Spatiales, Toulouse (France). Lab. D'Etudes et de Recherches en Teledetection Spatiale.
SUMMARY OF ANALYSIS AND PROCESSING TECHNIQUES USED ON SPOT IMAGERY
G. SAINT *In its* SPOT 1 Image Utilization, Assessment, Results p 1467-1472 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Image processing and analysis methods are reviewed, according to their capability to be used in operational systems or to their relationship with particular characteristics of SPOT. Methods in the two domains where SPOT can provide new types of observation : using the increased spatial resolution of the panchromatic mode and stereoscopic observations or the increased acquisition frequency associated with stereoradiometry are discussed. Cartography and photogrammetry show many improvements on accuracy, except for the identification of land use which remains the most crucial point to study for cost efficiency. ESA

N88-28505 SPOT Image Corp., Toulouse (France).
SPOT DATA ACQUISITION AND DISTRIBUTION
G. BRACHET *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1481-1503 1988 In FRENCH; ENGLISH summary Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The central catalog of all collected SPOT images includes the references of more than 500,000 scenes, of which 25 percent have less than 10 percent cloud cover and 30 percent a cloud cover of less than 25 percent. Among these, 35 percent were acquired in the panchromatic mode and 65 percent in the multispectral mode. More than 15,000 SPOT data were processed at the main archiving centers, 85% at level 1B, the most common processing level. Five thousand precision film transparencies were produced at a scale of 1:400 000 (full scene) or 1:200 000 (quarter scenes). Commercial distribution of SPOT data developed very rapidly in 1987, leading to 8000 products being distributed during the first 10 months, compared to 3000 in 1986. The proportion of digital products increases regularly within the large markets, while photographic products are still more commonly requested in less developed markets. The market share is also very strongly characterized by large sales in Europe (51 percent), North America (30 percent) and the Asia-Pacific region (12 percent). Also to be noted is the significant proportion of SPOT data distributed resulting from specific satellite imaging requests (30 percent), while the rest corresponds to orders of data already in the archive. ESA

N88-28506 Centre National d'Etudes Spatiales, Toulouse (France).
QUALITY OF SPOT IMAGES [LA QUALITE DES IMAGES SPOT]
G. BEGNI, P. HENRY, M. LEROY, and M. DINGUIRARD (Centre d'Etudes et de Recherches, Toulouse, France) *In its* SPOT 1 Image Utilization, Assessment, Results p 1505-1515 1988 In FRENCH
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The radiometric and geometric quality of SPOT images is discussed. Localization accuracy is 510 m (quadradic mean) for level 1B, 20m for level 2. Internal geometric accuracy is excellent. Superpositioning of SPOT images meets specifications. Altimetric accuracy for +27 deg/-27 deg views is 3.5 m, and 7 m for 0 deg/+27 deg. Radiometric quality (signal to noise ratios, absolute calibration, modulation transfer function) presents minor problems, which can be solved. ESA

N88-28509 SPOT Image Corp., Toulouse (France).
CLOSING OF THE PRELIMINARY EVALUATION PROGRAM FOR SPOT (PEPS): ASSESSMENT OF THE ACQUISITION, PRODUCTION, AND MONITORING OF PEPS [CLOTURE DU PROGRAMME PEPS: BILAN D'ACQUISITION DE PRODUCTION ET DE SUIVI DU PROGRAMME PEPS]
MICHEL POUSSE *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1535-1552 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The SPOT evaluation program, PEPs, is reviewed. Among the 316 answers received from the initial call for proposals, 127 were selected, coming from 32 countries and covering 10 major application areas. Thus over 500 laboratories throughout the world contributed to PEPS; 508 SPOT scenes were requested by Principal Investigators, most often with very specific viewing parameters, over 54 different countries. By the end of the Program, 91 percent of the requested images were acquired. ESA

N88-30166# Army Engineer Topographic Labs., Fort Belvoir, Va.
INTEGRATING MULTISPECTRAL IMAGERY AND GROUND LEVEL HYPERSPECTRAL SIGNATURE DATA
MELVIN B. SATTERWHITE 8 Apr. 1988 48 p
(AD-A195976; ETL-R-145) Avail: NTIS HC A03/MF A01 CSCL 17E

Present day state-of-the-art digital image processing hardware and software can provide the image analyst the opportunity to use multispectral imagery (MSI) and, in the future, hyper-spectral imagery (HSI) for evaluating and monitoring terrain and target features. However, the lack of training in the spectral signatures of terrain features can inhibit the analyst's interpretation of the multispectral false color composite image, prevent him from selecting the proper bands to achieve highest discrimination between the background and the target, and be a hinderance when he orders or displays a false color composite image. Training our analysts in the spectral signatures of terrain features should result in better exploitation of the pretty pictures. This training is

equally as important as learning the operation of the digital image processing equipment. Without it the analyst uses the MSI/HSI image as a mpa or as a photograph. He seldom or rarely uses the multispectral information within the image as part of his image analysis. GRA

N88-30315# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
METHOD FOR COMBINED IMAGE INTERPOLATION-RESTORATION THROUGH A FIR FILTER DESIGN TECHNIQUE
LEILA MARIA GARCIAFONSECA and NELSON DELFINODAVILAMASCARENHAS May 1988 12 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4561-PRE/1302) Avail: NTIS HC A03/MF A01

In digital image processing there is often a need to interpolate an image. Examples occur in scale magnification, image registration, and geometric correction. On the other hand, this image can be subjected to several sources of resolution degradation and an improvement of this resolution may be necessary. Therefore, the problem of combining the interpolation and the restoration in a single operation, thereby reducing the computational effort is addressed. This is done by means of a 2D, separable, FIR filter. The ideal low-pass FIR filter for interpolation is modified to account for the restoration process. The Modified Inverse Filter (MIF) is used for this purpose. The proposed method is applied to the interpolation-restoration of LANDSAT-5 Thematic Mapper data. The later process takes into account the degradation due to optics, detector, and electronic filtering. A comparison with the parametric cubic convolution interpolation technique is made. Author

08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A88-47438*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATMOSPHERIC EFFECT ON SPECTRAL SIGNATURE - MEASUREMENTS AND CORRECTIONS
YORAM J. KAUFMAN (NASA, Goddard Space Flight Center, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 26, July 1988, p. 441-450. refs

Measurements of the atmospheric effect on the spectral signature of surface cover were conducted during hazy conditions over the Chesapeake Bay and its eastern shore. In the experiment the upward radiance was measured by an airborne scanning radiometer in nine spectral bands between 465 and 773 nm, above and below the haze layer. Simultaneous measurements of the aerosol optical thickness and its vertical distribution were conducted. The results of the measurements are used to study the spectral dependence of the atmospheric effect on remote sensing of water bodies and vegetated fields (forest, corn field, and pasture), and to verify theoretical predictions. It is suggested that the radiances over dark areas (e.g., water in the near IR and forest in the visible) can be used to derive the aerosol optical thickness as is done over oceans with the CZCS satellite images. Combined with climatological information, the derived optical thickness can be used to perform corrections of the atmospheric effect. Examples of the derivation of the aerosol optical thickness and correction of the upward radiances are given. I.E.

A88-49084
METEOSAT OBSERVES THE EARTH
ANTONIO MARTINEZ DE ARAGON (ESA, European Space Operations Centre, Darmstadt, Federal Republic of Germany) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 54, Aug. 1988, p. 1217.

A88-49432
METHODS FOR ELIMINATING CONFLICTS BETWEEN OPERATION MODES OF AN EARTH-RESOURCE SATELLITE IN MISSION PLANNING [METODY USTRANENIIA KONFLIKTOV MEZHDU REZHIMAMI FUNKTSIONIROVANIIA KA IPRZ PRI SOSTAVLENII PROGRAMM RABOTY]
G. P. ANSHAKOV, A. V. SOLLOGUB, and D. G. BUNDOV Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), May-June 1988, p. 107-116. In Russian.

This paper presents tradeoffs for achieving the maximal performance of an earth-resources satellite. Using the discrete maximum principle and a dynamic programming procedure, algorithms were developed which make it possible to assign and to schedule conflict-free operation modes (each of which is set for maximal efficiency) for information collection and transfer, thus ensuring maximal efficiency of the mission. A numerical example is included. I.S.

A88-50285* Boston Univ., Mass.
THE USE OF VARIOGRAMS IN REMOTE SENSING. I - SCENE MODELS AND SIMULATED IMAGES. II - REAL DIGITAL IMAGES
CURTIS E. WOODCOCK (Boston University, MA), ALAN H. STRAHLER (Hunter College, New York), and DAVID L. B. JUPP (CSIRO, Div. of Water Resources Research, Canberra, Australia) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 323-379. refs
(Contract NAS9-16664)

Theoretical and empirical studies of variograms are presented. The sensitivity of variograms is studied through varyig parameters of scene models both in calculating explicit variograms and in simulating images. It is found that the heights of variograms are related to the proportion of an area covered by objects. It is shown that the range of influence of a variogram is related to the size of the objects in the scene and that the shape of the variogram becomes more rounded as the variance in the size distribution of objects increases. In the second part, empirically calculated variograms from real digital images are used to demonstrate these theoretical findings. These calculated variograms also show the periodicity in ground scenes and reveal anisotropy. R.B.

A88-50287* Environmental Research Inst. of Michigan, Ann Arbor.
PROCEDURES FOR USING SIGNALS FROM ONE SENSOR AS SUBSTITUTES FOR SIGNALS OF ANOTHER
G. SUITS, W. MALILA, and T. WELLER (Michigan, Environmental Research Institute, Ann Arbor) Remote Sensing of Environment (ISSN 0034-4257), vol. 25, Aug. 1988, p. 395-408. refs
(Contract NAS5-29356)

Long-term monitoring of surface conditions may require a transfer from using data from one satellite sensor to data from a different sensor having different spectral characteristics. Two general procedures for spectral signal substitution are described in this paper, a principal-components procedure and a complete multivariate regression procedure. They are evaluated through a simulation study of five satellite sensors (MSS, TM, AVHRR, CZCS, and HRV). For illustration, they are compared to another recently described procedure for relating AVHRR and MSS signals. The multivariate regression procedure is shown to be best. TM can accurately emulate the other sensors, but they, on the other hand, have difficulty in accurately emulating its shortwave infrared bands (TM5 and TM7). Author

A88-50353*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DETERMINATION OF A GEOCENTRIC COORDINATE FRAME FOR GPS MEASUREMENTS
S. C. WU and R. P. MALLA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: AIAA/AAS

Astrodynamics Conference, Minneapolis, MN, Aug. 15-17, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 1-7. refs
(AIAA PAPER 88-4210)

Two strategies for determining the offset from the geocenter for GPS measurements are considered. In the first strategy, VLBI-determined relative positions are used to fix the frame orientation and the absolute scaling, while the geocenter offset is determined from GPS measurements. In the second strategy, the absolute scaling is determined by the adopted gravitational constant of earth and the adjusted periods of GPS orbits, with the latitude being obtained from the time signature of earth rotation in the GPS measurements. The results indicate that geocentric positioning to an accuracy of a few centimeters can be achieved with just one day of precise GPS pseudorange and carrier phase data. R.R.

A88-50460
MILLIMETER WAVE RADIOMETRIC MEASUREMENTS FOR AIRBORNE AND GROUND BASED APPLICATIONS

J. A. GAGLIANO (Georgia Institute of Technology, Atlanta) IN: Millimeter wave technology IV and radio frequency power sources; Proceedings of the Meeting, Orlando, FL, May 21, 22, 1987. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 99-103. refs

A review of millimeter wave radiometric measurement programs performed for various external sponsoring agencies is the subject of this paper. Over the past ten years radiometric data have been gathered in the following areas: atmospheric water vapor, high altitude severe storm activity including hurricanes and tornadoes, Arctic ice and marginal ice zone signatures, detailed passive target signature data such as armored vehicles, and the detection of ice accumulation on the Space Shuttle external tank. The frequency region covered by the various measurement programs was from 35 GHz to 220 GHz. Author

A88-51714#
CURRENT AND NEAR-TERM (1990) TRENDS IN GPS RECEIVER TECHNOLOGY

JOSEPH A. CALABRIA (ORI, Inc., Warminster, PA) IN: Institute of Navigation, National Technical Meeting, Santa Barbara, CA, Jan. 26-29, 1988, Proceedings. Washington, DC, Institute of Navigation, 1988, p. 158-173. refs

This paper surveys 30 manufacturers of GPS equipment to assess their currently available receiver capabilities in terms of performance, size, weight, power, etc. The results show that 54 receiver models of varying complexity are available in 1987, and near-term projections identify at least 77 models of GPS receivers available by 1990. Nine manufacturers will have 20 GPS receiver models less than 200 cu in in size. Cost trends are presented for available GPS receiver models. The costs currently range from $15,000 to $45,000 with varying capability. By 1990, the introduction of modern GaAs and silicon integrated circuits and economies of scale will reduce the number of components in the receiver, thereby dramatically reducing the price of stand-alone receivers by at least 50 percent to the $7000 to $22,000 price range. C.D.

A88-52430#
SATELLITE REMOTE SENSING OF THE OPTICAL PROPERTIES OF THE SAHARA AND THE CLIMATOLOGICAL SIGNIFICANCE

WALTER G. EGAN (Lamont-Doherty Geological Observatory, Palisades, NY) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 95-114. refs

Two radiative transfer modes are applied to the prediction of climate trends in the western Sahara. One model, the Dave vector program, allows computation of the photometry and polarization of dust storms as well as the characterization of the solar flux divergence in the spectral range from the ultraviolet to the near infrared. The other model, LOWTRAN 5, computes the radiance and transmission of the atmosphere from the near infrared to the far infrared. As a result of the modeling and comparison to measurements, it appears that there will be a negligible change in the desertification of the western Sahara for the near future, although secondary feedback reinforced climatological events could become significant. It also appears that polarization can be a valuable adjunct to photometry in the remote sensing of Sahara dust aerosol. Author

A88-52431#
DECIPHERING WIND DIRECTIONS FROM DUNE ORIENTATIONS IN SPACE IMAGES OF DESERTS AND SEMIARID LANDS

MONIQUE M. MAINGUET (UN, Nairobi, Kenya) and FAROUK EL-BAZ (Boston University, MA) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 115-125. refs

The use of remote sensing techniques to study wind erosion in deserts and semiarid regions is examined. Two models of air movement at the earth's surface are presented: movement following high pressure cells in flat deserts, and deflection of air masses in arid areas with alternating mountains and flats. Landsat and Meteosat data are used to determine the distribution of sand deposits and dune orientations for regions in western Africa, Australia, the Arabian desert, and China. Synoptic wind systems and wind directions are extracted from this information. It is found that barchanic dunes, tranverse chains, and longitudinal dunes are indicators of wind direction. Linear dunes and isolated or scattered star dunes may be used to reveal the wind regime, but do not always reveal wind directions. R.B.

A88-52463#
MULTISENSOR IMAGERY COMPARISON IN SUDAN

MOHAMED ABDALLA MOHAMED (National Remote Sensing Centre, Khartoum, Sudan), HASSAN M. FADUL (Soil Survey Administration, Wad Medani, Sudan), and BARRY N. HAACK (George Mason University, Fairfax, VA) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 543-553. refs
(Contract NSF INT-85-19776)

Multisensor spaceborne imagery was obtained for three study sites in Sudan. Imagery was obtained from SIR A and B, Landsat MSS and TM, and stereoscopic photography from the Large Format Camera, Metric Camera, and Shuttle hand-held cameras. Visual and optical processing and analysis of the imagery included photographic processing techniques, optical overlays with a zoom transfer scope, and use of a color additive viewer for multisensor image integration. A comparison of the applicability of imagery from various sources to the study of cultural features, agriculture and vegetation, geology, geomorphology, and hydrology. It is found that SIR imagery was very useful for studying drainage patterns and allowed for penetration to subsurface features. Intersection of SIR A and B data at different azimuths provided little additional information. It was found that the MSS and TM data are important in studying surface composition with multitemporal spectral information from Landsat useful in studying vegetated landscapes. R.B.

A88-52468#
ERS-1 DATA PRODUCTS AND SERVICES AND THEIR VALUE FOR TROPICAL COUNTRIES

L. MARELLI (ESA, European Space Research Institute, Frascati, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 615-624.

The plans for the mission of ERS-1 are presented. The satellite's technical characteristics and data management system are discussed. The ERS-1 payload is described, including a radar altimeter operating at 13.7 GHz, an active microwave instrument operating at 5.3 GHz, an SAR with a swath width of about 100

km and a ground resolution of 30 sq m, and a wind scatterometer with three antennas. The value of ERS-1 data to tropical countries is considered, including weather and sea state forecasting, R.B.

A88-52473#
PERFORMANCE ANALYSIS OF A MICROLIGHT AIRCRAFT FOR RADIOMETRIC SURVEYING APPLIED TO LAND RESOURCES ASSESSMENT AND MONITORING IN MALI (WEST AFRICA)
J.-M. GREGOIRE, A. HUBAUX, and R. ZEYEN (CEC, Joint Research Centre, Ispra, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 705-713. refs

A88-52474#
THE AVHRR SPLIT WINDOW ALGORITHM FOR TROPICAL ATMOSPHERIC CONDITIONS
CARLO ULIVIERI (Roma I, Universita, Rome, Italy), ROBERTO LIGI, and GIOVANNI CANNIZZARO (Telespazio S.p.A., Rome, Italy) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 715-720. refs

This paper describes the study carried out to ascertain how the environmental conditions of low-latitude regions can affect the retrieved surface temperatures from satellite data. Simulations of NOAA-7 AVHRR/2 measurements have shown the necessity of including additive corrective terms in the split-window algorithm. An estimate of these terms is given for different atmospheric and surface conditions. Author

A88-52480#
THE USE OF SATELLITES IN WEATHER FORECASTING IN THE MASCARENES (INDIAN OCEAN)
S. RAGOONADEN (Meteorological Services, Vacoas, Mauritius) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 797-803.

The Meteorological Services of the region of the South-West Indian Ocean rely much on satellite pictures to provide weather forecast to various sectors. Satellites pictures from polar orbiting satellites - NOAA 6 and 9 are received twice daily, one in the morning and one in the afternoon. Two additional pictures are taken at night in case of bad weather and tropical cyclones. Different weather systems affecting the South-West Indian Ocean and their appearance on the satellite pictures are described briefly. It is proposed that a Geostationary satellite be made available over the Indian Ocean to enable countries in the region to follow more closely movement of weather systems to improve their weather forecast. Weather radar is another powerful tool available to meteorologists to track tropical cyclones when they are within a range of about 400 km from the radar. Mauritius has a 10 cm weather radar for this purpose. Author

A88-52492#
FIRST TESTS ON AERIAL TRIANGULATION OF CCD LINE-SCANNER IMAGES
P. LOHMANN, E. KRUCK, and G. KONECNY (Hannover, Universitaet, Hanover, Federal Republic of Germany) IN: International Symposium on Remote Sensing of Environment, 20th, Nairobi, Kenya, Dec. 4-10, 1986, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1987, p. 965-973. refs

An attempt for the evaluation of CCD line-scanner imagery is presented. This mathematical formulation considers central perspective geometry within a single line and allows easy implementation on analytical photogrammetric systems. The adjustment allows the use of additional frame camera images as well as other measurements. An anchor point file for the generation of orthophotos may be generated whenever DTM data are available. First results using a combined adjustment of Metric Camera photographs and MOMS data are presented. Author

A88-53034
CLOUD COVER DISTRIBUTION IN INDONESIA
J. P. GASTELLU-ETCHEGORRY (Gadjah Mada University, Yogyakarta, Indonesia) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1267-1276. refs

Indonesian spatiotemporal cloud cover distribution was quantified to allow planners to forecast probabilities for remote sensing data acquisition. The original data consisted of four randomly chosen Geostationary Meteorological Satellite displays per month from 1981 to 1985, which were analyzed with a micro-computer after a 1 deg 15 arcmin pixel size digitization. Iterative interactive factorial analyses combined with a parallelepiped classifier clustered data by grouping pixels with similar profiles. For all classes, pixel profiles were linearly combined to provide a small number of classes with high pixel-class correlations. A 07 correlation threshold led to 18 classes for all land areas. Statistics of Landsat and SPOT images, grouped by class, were used to verify, calibrate, and improve class profiles. This led to quantified temporal profiles of the probability of acquiring remotely-sensed data with a given cloud cover percentage for any Indonesian land and marine area. Author

A88-53035
PREDICTIVE MODELS FOR REMOTELY-SENSED DATA ACQUISITION IN INDONESIA
J. P. GASTELLU-ETCHEGORRY (Gadjah Mada University, Yogyakarta, Indonesia) International Journal of Remote Sensing (ISSN 0143-1161), vol. 9, July 1988, p. 1277-1294. refs

Indonesian spatio-temporal cloud cover distribution was quantified with the aid of Geostationary Meteorological Satellite (GMS) and Landsat data. For all land areas iterative interactive factorial analyses grouped GMS-derived pixels with similar cloud cover profiles into 18 classes. Statistics of Landsat and SPOT images, grouped by class, were used to quantify temporal profiles of probability of acquiring remotely-sensed data with 10 percent, 20 percent and 30 percent cloud cover for any Indonesian land area. Analysis of the spatio-temporal characteristics of local climatic conditions permitted one to explain these profiles and to verify the validity of their seasonal variations for long periods. These profiles were fitted with a seventh-order polynomial for use in computer simulation of predictive models of remotely-sensed data acquisition. Author

A88-53056* Miami Univ., Coral Gables, Fla.
COASTAL ZONE COLOR SCANNER ATMOSPHERIC CORRECTION - INFLUENCE OF EL CHICHON
HOWARD R. GORDON and DIEGO J. CASTANO (Miami, University, Coral Gables, FL) Applied Optics (ISSN 0003-6935), vol. 27, Aug. 15, 1988, p. 3319-3322. refs
(Contract NAGW-273; NAS5-28798; N00014-84-K-0451)

The addition of an El Chichon-like aerosol layer in the stratosphere is shown to have very little effect on the basic CZCS atmospheric correction algorithm. The additional stratospheric aerosol is found to increase the total radiance exiting the atmosphere, thereby increasing the probability that the sensor will saturate. It is suggested that in the absence of saturation the correction algorithm should perform as well as in the absence of the stratospheric layer. R.R.

A88-53677* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERFEROMETRIC SYNTHETIC APERTURE MICROWAVE RADIOMETRY FOR THE REMOTE SENSING OF THE EARTH
CHRISTOPHER S. RUF (California Institute of Technology, Jet Propulsion Laboratory, Pasadena), CALVIN T. SWIFT, ALAN B. TANNER (Massachusetts, University, Amherst), and DAVID M. LE VINE (NASA, Goddard Space Flight Center, Greenbelt, MD) (IEEE, URSI, NASA, et al., IGARSS '87 - International Geoscience and Remote Sensing Symposium, University of Michigan, Ann Arbor,

May 18-21, 1987) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 26, Sept. 1988, p. 597-611. refs

Interferometric aperture synthesis is presented as an alternative to real aperture measurements of the earth's brightness temperature from low earth orbit. The signal-to-noise performance of a single interferometric measurement is considered, and the noise characteristics of the brightness temperature image produced from the interferometer measurements are discussed. The sampling requirements of the measurements and the resulting effects of the noise in the measurements on the image are described. The specific case of the electronically steered thinned array radiometer (ESTAR) currently under construction is examined. The ESTAR prototype is described in detail sufficient to permit a performance evaluation of its spatial and temperature resolution. Critical aspects of an extension of the ESTAR sensor to a larger spaceborne system are considered. Of particular importance are the number and placement of antenna elements in the imaging array. A comparison of the implementation methodologies of radio astronomy and earth remote sensing is presented along with the effects of the source brightness distribution, the antenna array configuration and the method used for array scanning. I.E.

A88-55039
A COMPARISON OF WINDS OBSERVED AT CHRISTMAS ISLAND USING A WIND-PROFILING DOPPLER RADAR WITH NMC AND ECMWF ANALYSES
KENNETH S. GAGE, JOHN R. MCAFEE (NOAA, Aeronomy Laboratory, Boulder, CO), WILLIAM G. COLLINS (NOAA, National Meteorological Center, Washington, DC), DANIEL SOEDERMAN, HORST BOETTGER (European Centre for Medium-Range Weather Forecasts, Reading, England) et al. American Meteorological Society, Bulletin (ISSN 0003-0007), vol. 69, Sept. 1988, p. 1041-1046. refs

N88-26544*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ROLE OF SPACE BORNE IMAGING RADARS IN ENVIRONMENTAL MONITORING: SOME SHUTTLE IMAGING RADAR RESULTS IN ASIA
M. IMHOFF and C. VERMILLION Nov. 1986 24 p
(NASA-TM-101175; NAS 1.15:101175) Avail: NTIS HC A03/MF A01 CSCL 17I

The synoptic view afforded by orbiting Earth sensors can be extremely valuable for resource evaluation, environmental monitoring and development planning. For many regions of the world, however, cloud cover has prevented the acquisition of remotely sensed data during the most environmentally stressful periods of the year. This paper discusses how synthetic aperture imaging radar can be used to provide valuable data about the condition of the Earth's surface during periods of bad weather. Examples are given of applications using data from the Shuttle Imaging Radars (SIR) A and B for agriculture land use and crop condition assessment, monsoon flood boundary and flood damage assessment, water resource monitoring and terrain modeling, coastal forest mapping and vegetation penetration, and coastal development monitoring. Recent SIR-B results in Bangladesh are emphasized, radar system basics are reviewed and future SAR systems discussed. Author

N88-27612# Army Engineer Topographic Labs., Fort Belvoir, Va.
METHODS OF DETERMINING PLAYA SURFACE CONDITIONS USING REMOTE SENSING
J. P. HENLEY 8 Oct. 1987 11 p
(AD-A192663; ETL-R-135) Avail: NTIS HC A03/MF A01 CSCL 08F

Playas (dried lakes) commonly found in arid regions are geomorphic surfaces of importance for military and civilian use as aircraft landing sites, areas of easy or difficult vehicular movement, sources of dust produced by vehicles or munitions, and as a source of chemical and mineral deposits. The ability to remotely detect and determine the surface character of playas is of concern to the modern Army in preparing terrain intelligence for desert operations. To this end, 20 Mojave Desert playas were sampled and classified as to surface type, ranging from hard and dry to wet and soft. Spectral reflectance measurements were collected using a Geophysical Environmental Research IRIS MkIV spectroradiometer over the 400 to 2500 nm spectral range. This range includes the non-thermal bands of LANDSAT TM and all the bands of the Airborne Imaging Spectrometer (AIS). Physical and chemical analyses of the surfaces were compared to the spectral curves and to the surface character of the playas. Air photo pattern analysis was also used to determine special patterns associated with the surface types. The results show limited success in assessing the mineralogy important to surface hardness. The relative moisture conditions could be detected using reflectance spectra in the short wave infrared region and gypsum surfaces could be determined. The use of the spectral data in conjunction with air photo pattern analysis gave the best results for determining surface conditions. GRA

N88-28471 Technische Univ., Hanover (West Germany). Inst. fuer Photogrammetry and Engineering Surveys.
THE USE OF SPOT IMAGERY ON ANALYTICAL PHOTOGRAMMETRIC INSTRUMENTS
G. KONECNY, P. LOHMANN, H. ENGEL, and G. PICHT *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1173-1187 1988 Original contains color illustrations
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A method for the geometric processing of SPOT images was developed and implemented on analytical photogrammetric instruments. Level 1A film products as delivered by image distributors may be used on these instruments to produce digital elevation models, orthophotos, and line maps. The method was implemented and tested on Planicomp and Orthocomp hardware. A bundle adjustment program BINGO was modified to handle CCD line scanner geometry for the restitution of the images. Results using a panchromatic SPOT stereo pair over the area of Marseille (France) are presented. Good results for topographic mapping at 1:25,000 scale are expected. ESA

N88-28491 Satimage, Kiruna (Sweden).
PRODUCTION OF SATELLITE IMAGE MAPS BASED ON SPOT DATA
T. WESTIN *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1357-1363 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

A system for processing SPOT data, from the receiving antenna to the final printed map was implemented. The general processes and methods in the production line are described, including data acquisition, radiometric correction, geodetic adjustment, resampling, digital elevation model extraction, ortho-image production, mosaicing, map sheet sectioning, interpretation and production of cartographic overlays, and final map production. ESA

N88-28508 Centre National d'Etudes Spatiales, Toulouse (France).
PERSPECTIVES FOR THE SPOT PROGRAM [PERSPECTIVES DU PROGRAMME SPOT]
M. COURTOIS *In its* SPOT 1 Image Utilization, Assessment, Results p 1525-1534 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The payloads and products of the SPOT-1,2,3,4,5 satellites are summarized. These include vegetation sensors and image transmission via an optical link and data relay satellite. ESA

N88-28599# Naval Postgraduate School, Monterey, Calif.
STRATOCUMULUS AND CLOUD-FREE REFLECTANCE FROM MULTI-SPECTRAL SATELLITE MEASUREMENTS M.S. Thesis
FREDRICK M. TETTELBACH, JR. Dec. 1987 69 p
(AD-A193899) Avail: NTIS HC A04/MF A01 CSCL 20F

A summary of the multi-spectral radiative characteristics of marine stratocumulus clouds and pre-cloud suspended aerosols

was compiled for August 1986 over the offshore regions of the North American west coast. NOAA-9 AVHRR data were utilized at Channel 1 visible (0.63 micrometer), Channel 2 red visible/near infrared (0.90 micrometer), Channel 3 near infrared (3.7 micrometers), and Channel 4 thermal infrared (11.0 micrometers) wavelengths. Stratus cloud pixels and cloud-free area pixels were identified within the data set, and average radiation parameters with associated standard deviations were calculated for the two pixel classifications. The Channel 3 radiance values were reduced to reflectances through a unique procedure that removed the emittance from the total radiance using the detected Channel 4 emittance. GRA

N88-29250# Naval Postgraduate School, Monterey, Calif.
AN OBJECTIVE TECHNIQUE FOR ARCTIC CLOUD ANALYSIS USING MULTISPECTRAL AVHRR (ADVANCED VERY HIGH RESOLUTION RADIOMETER) SATELLITE IMAGERY M.S. Thesis
JOHN P. BARRON Mar. 1988 81 p Original contains color illustrations
(AD-A194732) Avail: NTIS HC A05/MF A01 CSCL 04B

An established cloud analysis routine has been modified for use in the Arctic. The separation of clouds from the snow and sea ice backgrounds is accomplished through a multispectral technique which utilizes very high resolution radiometer (VHRR) channel 2 (visible), channel 3 (near infrared) and channel 4 (infrared) data. The primary means of cloud identification is based on a derived channel 3 reflectance image. At this wavelength, a significant contrast exists between liquid clouds and the arctic backgrounds, unlike in the standard visible and infrared images. The channel 3 reflectance is obtained by first using the channel 4 emission temperature to estimate the thermal emission component of the total channel 3 radiance. This thermal emission component is subsequently removed from the total radiance, leaving only the solar reflectance component available for analysis. Since many ice clouds do not exhibit a substantially greater reflectance than channel 3, the routine exploits differences in transmissive characteristics between channels 3 and 4 for identification. The routine was applied to six case studies which had been analyzed by three independent experts to establish ground truth. Verification of the cloud analysis results, through a comparison to the subjective analyses, yielded impressive statistics. GRA

N88-30171# Alcatel Thomson Espace, Toulouse (France).
MICROWAVE REMOTE SENSING IN THE FRENCH INDUSTRIES
NORBERT LANNELONGUE 1987 10 p Presented at the French Aeronautical and Space Exhibition and Conference, Washington D.C., 20-23 Jan. 1987
(ETN-88-93081) Avail: NTIS HC A02/MF A01

French participation in the ERS-1, TOPEX/POSEIDON, VARAN-S, and passive radiometry projects is sketched. ESA

N88-30316# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A DIGITAL TERRAIN MODEL SYSTEM FOR A MICROCOMPUTER
CARLOS ALBERTO FELGUEIRAS, GUARACI JOSE ERTHAL, and LUIZ ALBERTO VIEIRADIAS Jun. 1988 10 p Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988
(INPE-4610-PRE/1333) Avail: NTIS HC A02/MF A01

The objective of this work is to describe the development and the implementation of a Digital Terrain Model (DTM), in a 16 bits microcomputer IBM-PC, under a MS-DOS Operational System. The model was developed at the Image Processing Department, Institute for Space Research (INPE), Brazil, and is integrated into a Geological Information System that allows the combination of DTM data with other information images and thematic maps. Author

N88-30524# Joint Publications Research Service, Arlington, Va.
DETERMINING NEAR-WATER WIND SPEED USING RADAR DATA FROM COSMOS-1500 ARTIFICIAL EARTH SATELLITE Abstract Only
G. V. VOLPYAN and YU. G. SPIRIDONOV *In its* JPRS Report: Science and Technology. USSR: Space p 22 26 Feb. 1988 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 3, May - Jun. 1987 p 3-11
Avail: NTIS HC A04/MF A01

The SEASAT satellite carried a two-ray radar apparatus designed to determine speed and direction of the near-water wind in a scanning zone 2 x 475 km. However, it is questionable if the instrument is optimal for solution of problems related to study of the near-water wind with respect to statistical reliability or spatial resolution. The side-looking radar on the Cosmos-1500 with a scanning zone of approximately 470 km has considerably better spatial resolution (about 1 x 2 km) compared to the American scatterometer. This side-looking radar can be used to study the spatial structure of wind fields in rapidly changing synoptic situations, such as along fronts, in hurricanes and squalls, and in some cases to obtain estimates of wind direction for forecasting purposes. The statistical reliability of these estimates is ensured by the possibility of selecting the required window of spatial averaging of radar data for each situation. The method and algorithm used to determine speed of the near-water wind using the physical calibration of side-looking radar relative to the known radar characteristics of multiyear sea ice are described. Author

09

GENERAL

Includes economic analysis.

A88-48446
REMOTE SENSING AND INTERNATIONAL SPACE LAW
CARL Q. CHRISTOL Journal of Space Law, vol. 16, no. 1, 1988, p. 21-44. refs

The UN Principles on Remote Sensing, which was approved in 1986, is presented in detail. The factors and key issues influencing the successful search for an agreement and are discussed, including conflicts concerning national privacy and sovereignty over natural resources, disagreement between sensing states and states without sensing capabilities, and differences in political and ideological perspectives. The negotiation process and the final articles of the resolution are described. Also, the legal status and importance of the 1986 Principles are examined. R.B.

A88-51423
SPOT - INITIAL USER REACTIONS
STEPHANE CHENARD Space Markets (ISSN 0258-4212), Summer 1988, p. 96-103.

The applications of SPOT images and the responses of public and private users from the SPOT Preliminary Evaluation Program are examined. It is found that the image quality from SPOT is good, although it has declined with age. The problem of processing and producing imagery is discussed. The use of SPOT images for the news media, cartography, environmental planning, agronomy and vegetation studies, hydrography, maritime studies, and mining and petroleum extraction are considered. R.B.

N88-25943# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNIQUE TO OBTAIN THE AGRICULTURAL OWNERSHIP LIMITS BY SATELLITE IMAGERY, TO APPROVE CONTROL, AND TO ACCOMPANY AGRICULTURAL ACTIVITY [TECNICA PARA OBTER LIMITES DE PROPRIEDADES AGRICOLAS SOBRE IMAGENS DE SATELITE, VISANDO CONTROLAR E ACOMPANHAR A ATIVIDADE AGRICOLA]
VALDETE DUARTE *In* Instituto de Pesquisas Espaciais, National

Meeting on Remote Sensing Applied to Municipal Planning p 49-57 1987 In PORTUGESE
Avail: NTIS HC A14/MF A01

The contents are an integral part of the comprehensive project designated FISATE (supervision of agricultural ownership by satellite), routinely conducted through INPE by a pact with the Bank of Brazil, S.A., through its Incentive Fund for Technical-Scientific Research (FIPEC). This opportunity is evidence of the stage of cadastral agricultural ownership by aerial photographic registry and transposition to satellite imagery in 1:100,000 scale. This methodology certifies control and unites the agricultural activity through satellite imagery. Making use of this establishes the following: aerial photographs of records in the 1:35,000 scale; photoindex in the 1:100,000 scale; and IBGE topographical maps in the 1:250,000 and 1:50,000 scales. An officer of the Bank of Brazil, bound to the banking agency of the Assis municipality (SP), receives training with the purpose of becoming capable in the handling of aerial photographs and to qualify for executing assignments concerning the collection of information for obtaining the assessed lands of agricultural ownership. Once demarcated, the limits of agricultural ownerships which receive financing for planting are transferred from the cartographic basis, 1:50,000 scale, over the aerial photographs, through the KARTOFLEX equipment. This draft is reduced photographically to a 1:100,000 scale, compatible with the satellite imagery. The final product is a transparency containing the agricultural ownership of the bank customers. The farming interests of the bank are verified and united through satellite imagery. Author

N88-28501 Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France).
TRAINING OF THE GROUP FOR THE DEVELOPMENT OF AEROSPACE REMOTE SENSING
DANIEL BURETTE, ALAIN PINGANAUD, and PIERRE-YVES REVILLION *In* CNES, SPOT 1 Image Utilization, Assessment, Results p 1451-1456 1988 In FRENCH; ENGLISH summary
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Long term and short term training courses for remote sensing novices and experienced personnel in English and French are indicated. The courses take place in France. Tailor-made courses are possible. ESA

N88-28504 Centre National d'Etudes Spatiales, Toulouse (France).
THE SPOT PROGRAM
M. COURTOIS *In its* SPOT 1 Image Utilization, Assessment, Results p 1473-1479 1988
Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

In-orbit performance of SPOT-1; in-flight anomalies; ground segment, SPOT-4 payload, and project management are summarized. ESA

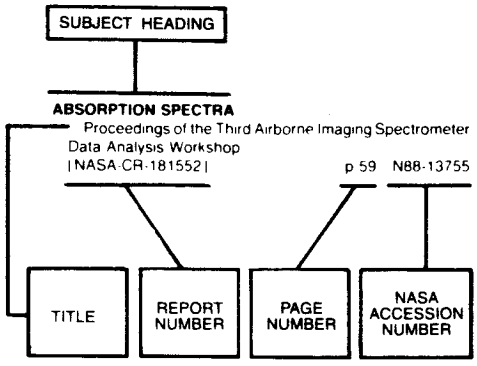
N88-29714# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
ACTIVITIES REPORT IN REMOTE SENSING Annual Report, 1986 [JAARVERSLAG 1986]
1986 104 p In DUTCH
(ETN-88-92905) Avail: NTIS HC A06/MF A01

The execution of the Dutch National Remote Sensing Program (NRSP) is reviewed. The NRSP projects are tabulated. Other projects, closely related to the NRSP, are mentioned. The tasks of the different groups within the NRSP are outlined, including radar investigation of water, vegetation, crop recognition, models, soil, and forest, as well as optical remote sensing of water and land. ESA

N88-30265# World Meteorological Organization, Geneva (Switzerland).
ACTIVITIES REPORT OF THE WORLD METEOROLOGICAL ORGANIZATION Annual Report, 1987
1988 223 p
(WMO-689; ISBN-9-26-310689-4; ETN-88-92716) Avail: NTIS MD A01; print copy available at World Meteorological Organization, Case Postale no. 5, CH-1211 Geneva 20, Switzerland

The status of the World Meteorological Organization's World Weather Watch, World Climate, research and development, applications of meteorology, hydrology and water resources, education and training, technical cooperation, and regional programs is summarized. ESA

Typical Subject Index Listing



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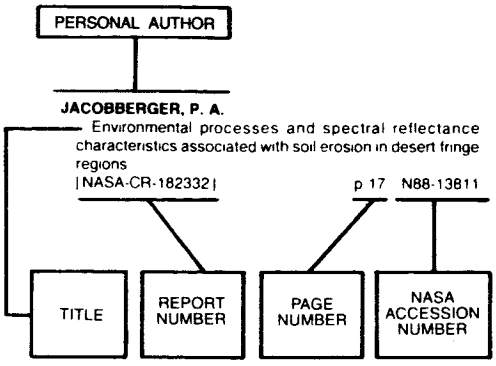

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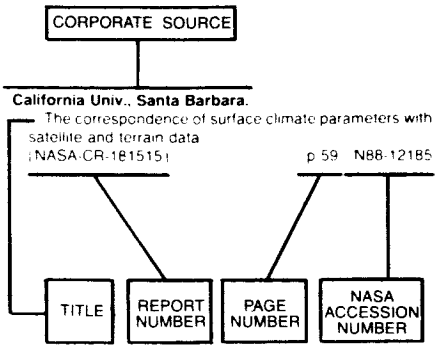

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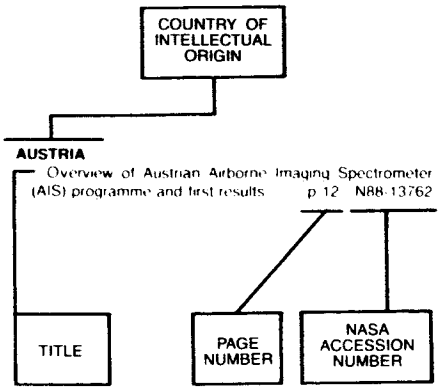

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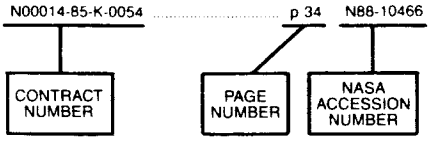

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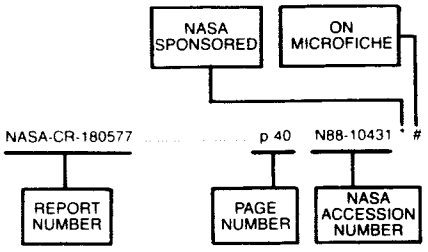

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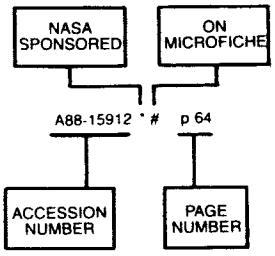

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